Water Line Repair Exercise

Instructor's Copy

Behavioral Research Aspects of Safety
and Health Group (BRASH)
Institute for Mining and Minerals Research (IMMR)
University of Kentucky, Lexington, Kentucky[1]

[1] This exercise was developed and field tested under U. S. Bureau of Mines research Contract No. H0348040. Information about the design and characteristics of the exercise and the field test results are available in the project technical reports filed with the Bureau of Mines Research Center in Pittsburgh, PA. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or the U. S. Government.

Contents

Introduction

This document contains most of the materials needed to use the exercise. The main part of the document is the instructor's copy. It tells how to use the exercise, presents the objectives, the problem booklet, the master answer sheet, the scoring key, and discussion notes to be used following the exercise. The last part of this document is three appendices. Appendix A is the exercise problem booklet. This booklet can be duplicated locally. The booklets are reusable. One is needed for every person in the classroom. Appendix B is the answer sheet. Copies of this answer sheet must have the invisible ink answers that appear in Appendix C printed on them[2]. Answer sheets are consumable. One is needed for each small group of 3 to 5 persons who work the exercise.

Exercise Summary

Read this section first. It determines if the exercise is appropriate for your classes. If you choose to use the exercise, examine the table of contents and review the remainder of this document.

Type:	Invisible ink
Length:	Ten questions (20 minutes administration plus 30 minutes for discussion)
Skills:	Recognizing signs and symptoms of carbon monoxide intoxication Choosing among escape routes and procedures for rescuing one's self and an unconscious miner from a toxic mine atmosphere Recalling probable sources of carbon monoxide and the amounts that are disabling and fatal for given time periods Recalling means to detect the presence of carbon monoxide
Location:	Underground
Problem:	You and your supervisor, Big Tom Bell, are repairing a water line in the belt entry of a mine. You are 1,200 feet from the portal and 800 feet from the nearest phone which is inby your position at the tailpiece. You smell something like burning coal. Tom sends you into the return air entry to get a tool from the scoop you drove in. When you come back into the belt entry, Tom is unconscious. You feel sick and weak. You have to decide what to do to help Tom and yourself.

[2] You can do this yourself if you have the proper equipment, or you may obtain copies of preprinted answer sheets from NIOSH, Pittsburgh Research Laboratory, Pittsburgh, PA phone 412-386-5901, fax 412-386-5902 or email to minetraining@cdc.gov.

How to Use This Exercise

1. Look at the performance objectives. Decide if the exercise is relevant for your mine training class.

2. Work through the exercise with the developing pen and score your responses.

3. Read the master answer sheet for the exercise. Look at all the answers.

4. Read the "Instructor's Discussion Notes" for the exercise.

5. Become thoroughly familiar with the problem so that you can present it to your class without reading it. Put the maps on an overhead projector so you can use these to help explain the problem.

6. When you present the exercise to the class:

   - Give each person an exercise booklet, and each small group of 3 to 5 an answer sheet and a developing pen.

   - Demonstrate how to select and mark answers using the developing pen.

   - Go over the instructions for doing the exercise with the whole group.

   - Explain the problem making sure everyone understands the problem situation.

   - Have the class members work the exercise.

   - When the class members finish, have them figure up their score using the instructions at the end of the exercise.

   - When everyone has finished, discuss the exercise. Let class members discuss the merits of each answer. Add your own ideas.

Performance Objectives for Water Line Repair Exercise

Objective number		Capability yerb(s)	Description of required performance and conditions under which it is to occur
1.	MG[3]	Recall Recognize	CO as a combustion product that may exist in dangerous levels without fire or smoke being apparent
2.	MG/FA	Recognize Classify Discriminate	Primary sensory cues and mine environment cues that signal possible presence of fire, CO, and other toxic combustion products
3.	MG/FA	Recognize Identify Discriminate	Physiological symptoms of CO intoxication in self and others under varying levels and exposure times
4.	MG/FA	Recall Identify Describe	Concentrations of CO that are just noticeable, debilitating, incapacitating, and fatal for given exposure times
5.	MG/FA	Recall Recognize Identify	Approximate recovery time from acute CO intoxication in terms of capability to move about, do work, and think clearly
6.	MG/EE	Recall Identify Recognize Describe	Purpose and limitations of the FSR unit including: the concentrations of CO for which it is effective, that its heat generation is proportional to CO concentration, how long it protects under various levels of CO, its failure to protect against oxygen-deficient air, and the physical responses required of the user (sealing mouthpiece in place with lips, biting lugs with molars, keeping nose clips on)
7.	MG/EE	Recall Recognize State	Purposes of the SCSR apparatus including: its protecting from all mine gases, the approximate duration of the oxygen supply under varying amounts of work, the physical responses reauired of the user for effective use (keeping lips sealed around mouthpiece, ing lugs with molars, nose clips on, breathing from the bag to obtain oxygen), and that operating temperature is not related to CO levels
8.	EE	Choose Judge Predict	From among alternative courses of actions those that are effective for escape from a hazardous area given a problem situation, a mine map and other information and constraints
9.	EE	Recognize Identify Plan Generate	Escape procedures and routes by which to rescue sefl and others from a toxic mine atmosphere given a simulated mine emergency maps, conditions, such as the location of the emergency, number of persons working nearby, distance and barriers to fresh air, prevailing conditions in the mine, etc.

3 Skill and knowledge domain abbreviations:
FA = first aid
MG = mine gases
EE = emergency evacuation and escape

Master Answer Sheet for Water Line Repair

Use this answer sheet to mark your selections. Rub the developing pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you have made a selection. Otherwise you may not get the information you need. The last part of the message will tell you what to do next.

Question A (Choose only ONE unless you are told to "Try Again!")

1. [You can't. You get weak and pass out after one crosscut. Try again!]

2. [You can't. You get weak and pass out after one crosscut. Try again!]

3. [Correct! Do the next question.]

4. [You pass out after giving Tom a few breaths. Try again!]

Question B (Choose only ONE unless you are told to "Try Again!")

5. [Try again!]

6. [Try again!]

7. [Try again!]

8. [Correct! Do the next question.]

Question C (Choose only ONE unless you are told to "Try Again!")

9. [Correct! This will alert others and bring help. Do the next question.]

10. [Can't. You have your FSR on. If you take it off you and Tom may both die.]
    [No one will know you are in trouble. Try again!]

11. [Would take too long. Tom will die. Try again!]

12. [Would waste time. You need to get Tom out of carbon monoxide fast if he is]
    [to live. Try again!]

Question D (Choose only ONE unless you are told to "Try Again!")

13. [Too far. You are too weak. You collapse after one crosscut. Try again!]

14. [Correct! You have a chance to save Tom and yourself. Intake air is closer]
[than return air and probably cleaner. Do the next question.]

15. [Would waste time. Tom is unconscious and can't keep the mouthpiece in.]
[Carbon monoxide will still get into his lungs. Try again!]

16. [Too far! You are too weak. Return air could be bad too. Try again!]

Question E (Choose only ONE unless you are told to "Try Again!")

17. [Would waste time and increase the risk to Tom and you. Try again!]

18. [Correct! You have a chance to save Tom and yourself! Do the next question.]

19. [Would take too long. Tom will die and you may too. Try again!]

20. [SCSRs too far away. Tom will die and you may not get to the scoop.]
[Anyway, Tom is unconscious and can't breathe through the unit. Try again!]

Question F (Choose only ONE unless you are told to "Try Again!")

21. [Tom would die. You are too weak to travel. Try again!]

22. [Tom would die. You are too weak to get Tom out. You can't move fast. Try]
[again!]

23. [Correct! Fresh intake air will blow over and protect Tom. You can watch and]
[signal for help. Do next question.]

24. [Tom would die. You are too weak to travel. Try again!]

Question G (Choose only ONE unless you are told to "Try Again!")

25. [Not likely. A cable fire at the face would produce smoke. Fumes would be]
[swept out the return air. Try again!]

26. [Not likely. Old works produce oxygen deficient air (blackdamp) containing]
[carbon dioxide. Anyway, gases at the face would be swept out the return air.]
[Try again!]

27. [Not likely. Bleeders usually contain methane. Carbon monoxide is not likely]
[unless there was a fire in the gob. Anyway, gases from the gob would not]
[likely be present in the neutral air of the belt entry. Try again!]

28. [Correct! Coal on the floor by the belt can be ignited by a hot roller bearing.]
[The coal dust can burn without smoke or flame for several hours or days and]
[produce deadly levels of carbon monoxide. Do the next question.]

Question H (Choose only ONE unless you are told to "Try Again!")

29. [Correct! The 15 minute threshold limit value (TLV) for carbon monoxide is]
[0.04 percent (1/25 of = percent). Here the concentration is 1/5 of <u>one</u>]
[percent, or 5 times greater. This will produce unconsciousness in 30 minutes]
[and death in less than one hour. Do the next question.]

30. [Even if he lives, recovery will take hours. Blood has 300 times greater]
[attraction for carbon monoxide than for oxygen. Even a tiny amount of this]
[gas in the air prevents the blood from taking on oxygen. Try again!]

31. [Even if he lives, recovery will take hours. Blood has 300 times greater]
[attraction for carbon monoxide than for oxygen. Even a tiny amount of this]
[gas in the air prevents the blood from taking on oxygen. Try again!]

32. [This much will make even the strongest person unconscious in less than 30]
[minutes. Try again!]

Question I (Choose only ONE unless you are told to "Try Again!")

33. [The flame safety lamp would appear normal. Oxygen in the air would be]
[decreased hardly at all. Yet carbon monoxide would be present in a tiny but]
[deadly amount. Try again!]

34. [Methane detectors don't measure carbon monoxide. Try again!]

35. [Oxygen analyzers are more accurate than flame safety lamps. But in this]
[situation the oxygen reduction is so small the analyzer will give a normal]
[reading. Yet the tiny amount of carbon monoxide may be fatal. Try again!]

36. [Correct! The best detector among those listed is you! The smell of coal]
[burning, your knowledge of mine gases, what happened to Tom, your]
[headache, nausea, and weakness should all lead you to suspect carbon]
[monoxide. Do the next question.]

Question J (Choose only ONE unless you are told to "Try Again!")

37. [Try again!]
[ ]
[ ]
[ ]

38. [Try again!]
[ ]

39. [Correct! Carbon monoxide is almost the same weight as air. It has no]
[preference for top or bottom, although in hot smoke it rises to the top with the]
[hot air. By itself it is odorless and colorless. In quiet air it collects near the]
[material that is burning. END OF PROBLEM.]

40. [If heavier, it would collect near the mine floor. Try again!]
[ ]

Finding your score

Number of "Correct" answers you colored in = (1)_____

30 minus number of incorrect answers you colored in = (2)_____

Add blanks one and two to get your total score = (3)_____

Highest possible score = 40

Lowest possible score = 0

Instructor's Discussion Notes for Water Line Repair

Use the information presented here and in the problem booklet, your own ideas and experience, and those of the miners in your class to discuss the exercise after it has been completed. Group discussion can help strengthen knowledge and skills, correct errors, and relate the exercise content to the experiences of the miners. After they have worked the exercise, miners enjoy discussing the problem. They also frequently think of better ways to respond to a problem than those listed among the answers. The purpose of the exercise is to help the miners think about and remember basic knowledge and skills they may someday need to deal with a mine emergency. The discussion following the exercise can contribute to this goal and tailor the exercise content to the needs of the group.

It is helpful to show overhead transparencies of the master answer sheet during the discussion. This allows you to lead the group through the exercise and to disclose and discuss all the answers to each question. Most of the information about why particular answers are correct or incorrect is given on the master answer sheet.

The following notes are intended to provide additional information for you as you discuss the exercise with your class. Read through and think about the notes before the class. Don't read the notes to the class members. This would be boring and ineffective. Rather, incorporate the ideas you find here with your own ideas and make these points at the appropriate place in the discussion of the exercise.

Question A - Answer 3 is correct. Any of the other actions would lead to loss of consciousness for both miners. The symptoms indicate there is very little time in which to get out of this area alive.

Question B - Answer 8 is correct. These are the classic signs of carbon monoxide poisoning. These symptoms and other cues like the smell of burning coal should also make you suspect carbon monoxide.

Question C - Answer 9 is correct. The voltage on the belt control line is about the same as a telephone line (34 to 40), and is too low to hurt anyone when the line is broken. Some miners say cutting the belt control line (9) would not bring help because this safety device is often "jumped out." You might use this opportunity to illustrate why safety devices should not be disabled. The other actions listed would contribute to Tom's death. Taking the time to examine Tom and give him first aid (12) might kill both men. The first priority is to get out of this area into fresh air.

Question D - Answer 14 is correct. When the FSR gets hot that is a sign of a deadly amount of carbon monoxide in the air. Rolling Tom under the belt and pulling him to the mandoor to the intake air is the shortest route and requires the least time and effort. With as much carbon monoxide as the first miner already has in his system, he will be weak and slow. Dragging Tom (13, 16) would require too much effort. Putting Tom's FSR on him (15) would waste time and do no good because contaminated air would still come in around the mouthpiece and get into Tom's lungs. An unconscious person

cannot hold the mouthpiece in place. The breathing resistance of the FSR makes the air flow around rather than through the unit unless the mouthpiece is sealed firmly.

Question E - Answer 18 is correct. The intake air needs to be checked. Sitting next to Tom and waiting (17) would waste time and be risky to both miners. Leaving Tom where he is and crawling (19, 20) would take too long and require too much effort. Putting a SCSR unit on Tom (20) would only work if you kept his mouth and lips sealed around the mouthpiece and had his nose clips on. He is unconscious and can't hold the mouthpiece in. Contaminated air would still get into his lungs. The 300 times greater preference of blood for carbon monoxide would make the oxygen ineffective.

Question F - Answer 23 is correct. Leaving the mandoor open will protect Tom. Fresh air will blow in, sweeping the contaminated air away from him. Keeping the door open will also tend to dilute and short-circuit the belt air. Therefore, less carbon monoxide will move toward the face so this action also helps to protect the miners at the face. Closing the door (21, 22, 24) will contribute to his death. The source of the CO is probably outby Tom's position, because the belt air is moving inby in this exhausting ventilation system.

Question G - Answer 28 is the most likely for reasons explained in the invisible ink portions of the answers. This type of smoldering fire in the coal dust around conveyor belts is a common cause of mine fires and accidents according to MSHA investigations.

Question H - Answer 29 is correct. A concentration 0.16 % (sixteen one hundredths of one percent) is enough carbon monoxide to render a miner unconscious in slightly over one-half hour. See the attached chart (Figure 3) from H. L. Hartman, (1982) Mine Ventilation and Air Conditioning (2nd ed.), New York: Wiley, p. 46. You may want to show this chart to your class and discuss how little of a concentration of carbon monoxide is noticeable, debilitating, incapacitating, and fatal for various exposure times. Miners and instructors often misread values like 0.20% thinking this is 2 percent or 20 percent: Actually the value is two tenths of one percent, a very small but also a deadly amount of carbon monoxide.

Question I - Answer 36 is correct. Because the fire is small and slow burning, it uses up very little oxygen. Air on the belt entry also moves in toward the face and would supply oxygen. The small amount of carbon monoxide produced would be deadly. Yet the oxygen level in the air would be depleted only a fraction of a percent, too little to notice with even very good instruments. However, a carbon monoxide detector would provide warning of the presence of the gas.

Question J - Answer 39 is correct. Carbon monoxide has a density almost the same as air. It will usually accumulate near the source of combustion. It tends to rise toward the top with hot air and smoke when there is a fire because hot air is lighter than cooler air.

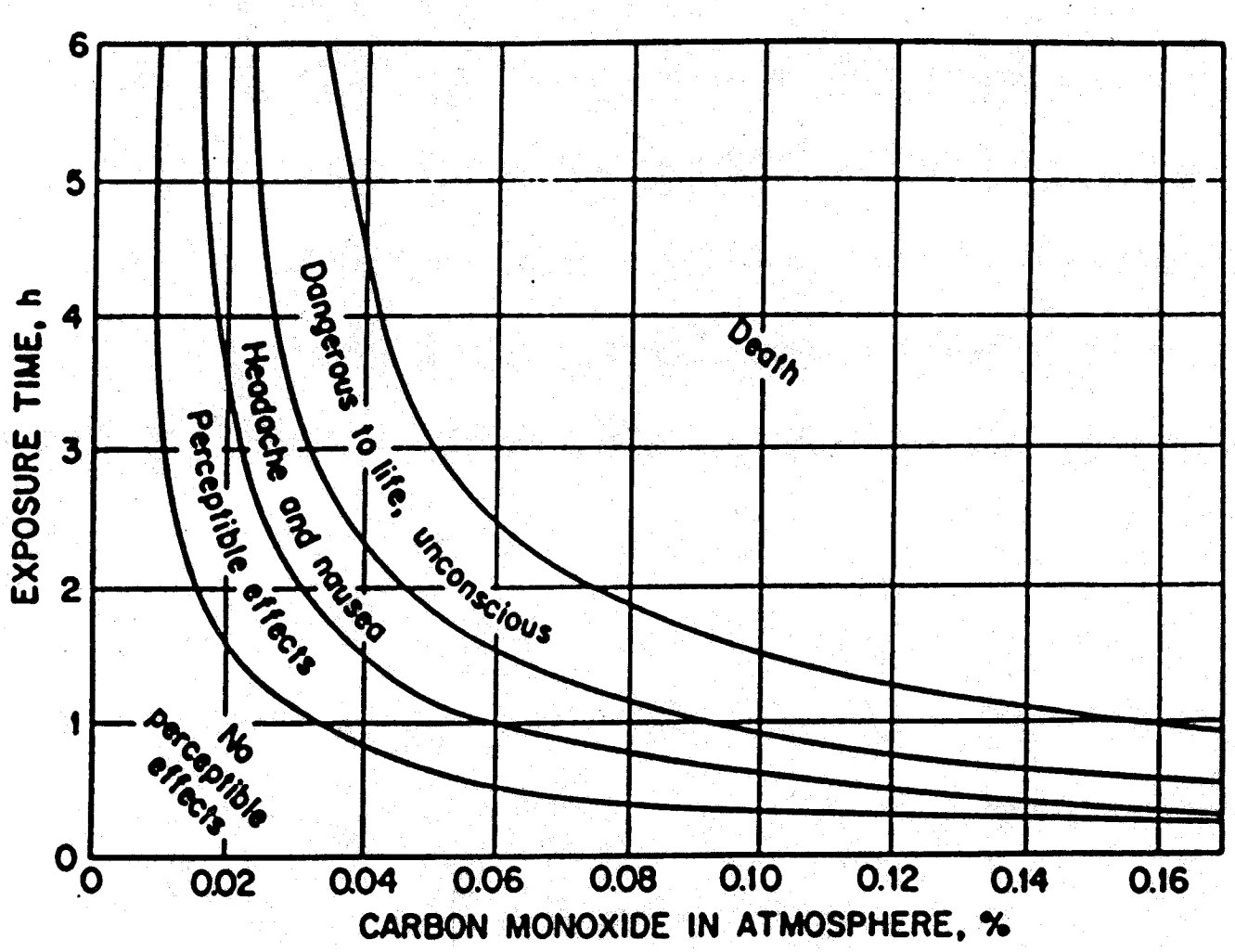

Figure 3: Toxicity of carbon monoxide as a function of concentration and time. (Hartman, Mutmansky; Wang 1982.)

References

Miller, E. J., & Dalzell, R. W. (1982). Mine gases. In H. L. Hartman, J. M. Mutmansky, & Y. J. Wang (Eds.), Mine ventilation and air conditioning (2nd ed.) (pp. 39-68). New York: Wiley.

Mine Safety and Health Administration. (1980). First aid book. (pp. 22, 190). Beckley, WV: National Mine Health and Safety Academy.

Mosgrove, J. H. (1981). Mine gases. In D. F. Crickmer, & D. A. Zegeer (Eds.), Elements of practical coal mining (2nd ed.) (pp. 253-271). New York: Society of Mining Engineers.

National Mine Health and Safety Academy (1984). Coal mine ventilation awareness program. Beckley, WV: Author.

Scoring Key for Water Line Repair

The correct answers are marked with an asterisk.[4]

Question	Answer Number			
A	1	2	3*	4
B	5	6	7	8*
C	9*	10	11	12
D	13	14*	15	16
E	17	18*	19	20
F	21	22	23*	24
G	25	26	27	28*
H	29*	30	31	32
I	33	34	35	36*
J	37	38	39*	40

[4] This page is printed in large type so that it may be copied and used as an overhead transparency.

Appendix A: Problem Booklet

Duplicate this copy of the problem booklet for use in your classes. **Booklets should be printed on only one side of the paper.** Each person in your class should have a problem booklet while they are working the exercise. The problem booklets are reusable.

You may obtain a copy of the problem booklet from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to lord-mary@msha.gov.

Water Line Repair

Problem Booklet

Instructions

Read the problem on the next page and study the map on page 4. Think about the problem for a moment. You will be asked a series of questions. Each question is followed by four choices. There is one correct choice for each question.

After you have selected a choice to a question, look up the number for that choice on the answer sheet. Rub the developing pen between the brackets by your choice. A message will appear and tell you if this is correct or if you need to "Try again!" The object is to select the correct answer for each question in as few attempts as possible.

Read the questions one at a time. Don't jump ahead. However, you can look back at previous questions and your answers anytime you wish.

At the end of the exercise you will learn how to score your performance.

Now, turn the page and begin the exercise.

Problem

You are working with Big Tom Bell repairing a leaking water line in neutral air beside the belt in # 3 entry. The permissible scoop you and Tom used to bring in your tools is parked in the #2 entry, part of the return airway. (See the map in Figure 1.)

The coal is 48 inches high. The belt is running. There are 10 workers at the face 1000 feet inby your position.

As you work in the belt entry you smell something like burning coal. There is no sign of smoke. Tom tells you not to worry about the smell, that it is just the fumes from a hot bearing on a belt roller a few crosscuts outby. He tells you the bearing was replaced a little while ago. You soon get a bad headache.

Tom sends you back into the return air to the scoop to get a tool. When you come back into the belt entry your head still aches and you feel sick to your stomach. You still smell something like coal burning. You quickly look inby and outby. There is no smoke. Everything looks normal.

As you move outby toward Tom you see his cap lamp on the mine floor. You yell to him and he doesn't answer. When you reach him he is lying on the ground unconscious.

Think about this situation. Study the mine map on the next page. When you are ready, turn the page and answer the questions.

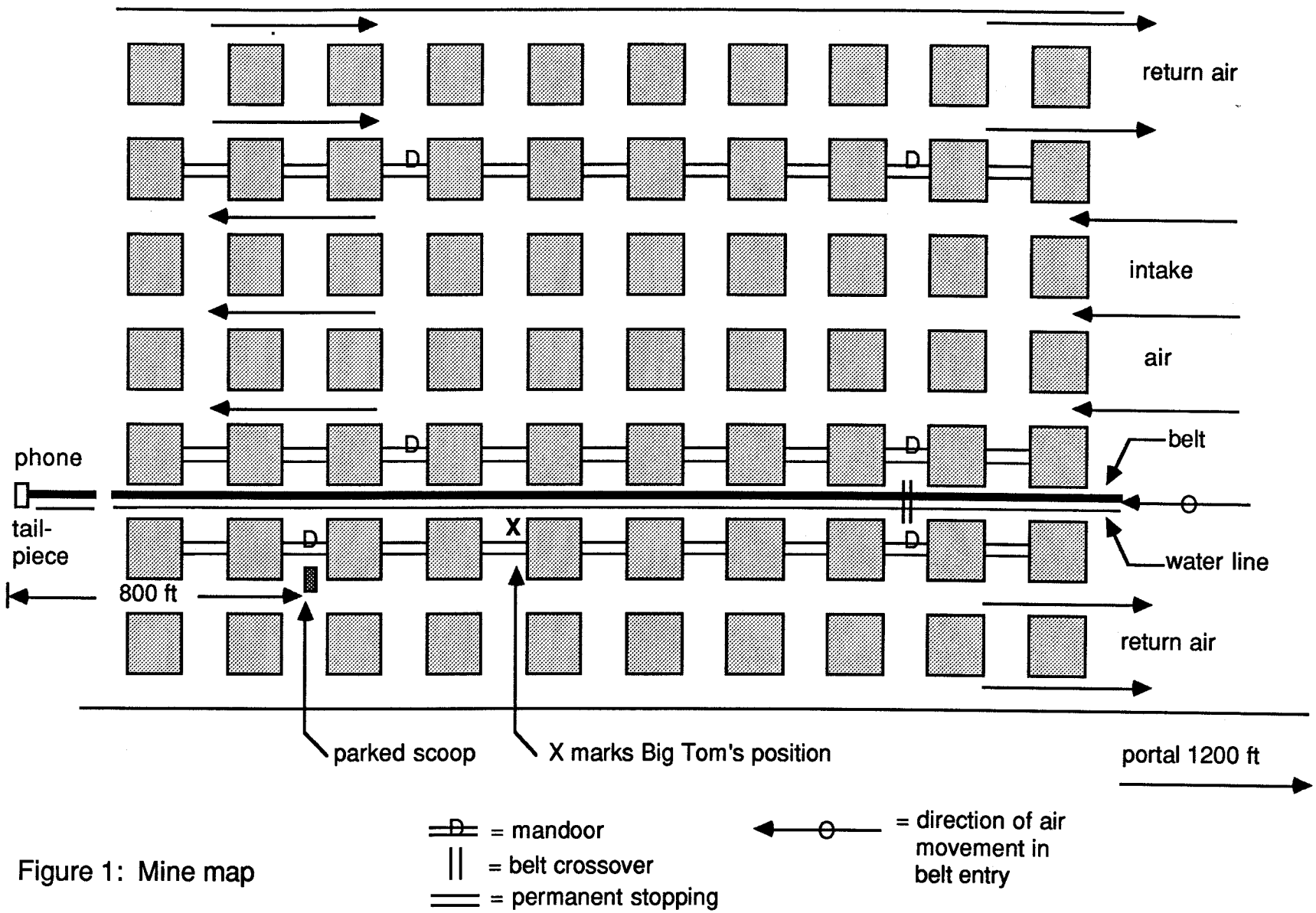

Figure 1: Mine map

Question A

At this point it would be best to:

1. Grab Tom and drag him two crosscuts back toward the mandoor where the scoop is parked and get him in the return air.

2. Grab Tom and drag him outby five crosscuts to the belt crossover and get him into the intake air.

3. Put your filter self-rescuer on yourself, (the one you have on your belt).

4. Check Tom to see if he is breathing and give him mouth to mouth resuscitation if he is not.

Question B

You put on your filter self-rescuer (FSR). You have a throbbing headache and you feel short of breath, dizzy, and weak. You are still in the belt entry with Tom. (See Figure 1.) He is still unconscious. When you look at him closely you see his face and lips have a red flush.

At this point you should suspect:

5. Methane.

6. Blackdamp (oxygen deficient air).

7. Heart attack.

8. Carbon monoxide.

Question C

You are still in the belt entry with Tom. He is still unconscious. At this point it would be best to:

9. Cut the belt safety line (also called the belt control line).

10. Give Tom CPR.

11. Hurry back to the scoop in the return air, tram outby and call for help.

12. Carefully examine Tom to see if he has any other injuries and give him first aid if he needs it.

Question D

You cut the safety line and the belt stops. You are still in the belt entry with Tom and he is still unconscious. (See Figure 1.) Your filter self-rescuer is getting hot as you breathe through it.

At this point it would be best to:

13. Drag Tom five crosscuts outby to the belt crossover and through the mandoor into the intake airway.

14. "Logroll" Tom under the belt, drag him inby one crosscut and then pull him up to the mandoor into the intake airway.

15. Take Tom's filter self-rescuer out and put it on him so he can breathe through it.

16. Drag Tom two crosscuts inby and through the mandoor to the scoop in the return airway.

Question E

You are very weak and have a pounding headache. You feel like you will vomit. Your thinking is slow and difficult. With great effort you get Tom rolled under the belt toward the intake air. After this you have to stop and rest. The air coming through your filter self-rescuer is getting hotter. Now you drag Tom inby into the crosscut near where the mandoor goes into the intake air. You are so weak you can't drag him any further. (Look at Figure 2 below.)

Now it would be best to:

17. Sit quietly next to Tom waiting to get your breath back so you can continue to drag him to the mandoor and into the intake air.

18. Leave Tom where he is (in the crosscut by the mandoor to the intake air). Feel the door. If it is cool, open the door, and check the air.

19. Leave Tom where he is, crawl back under the belt, go through the mandoor to the scoop, tram inby to the phone at the tailpiece and call for help.

20. Crawl back under the belt, go through the mandoor into the return air to the scoop. Tram inby to the tailpiece where the oxygen generating SCSR's are located. Put one on yourself and take the other one back to Tom and put it on him.

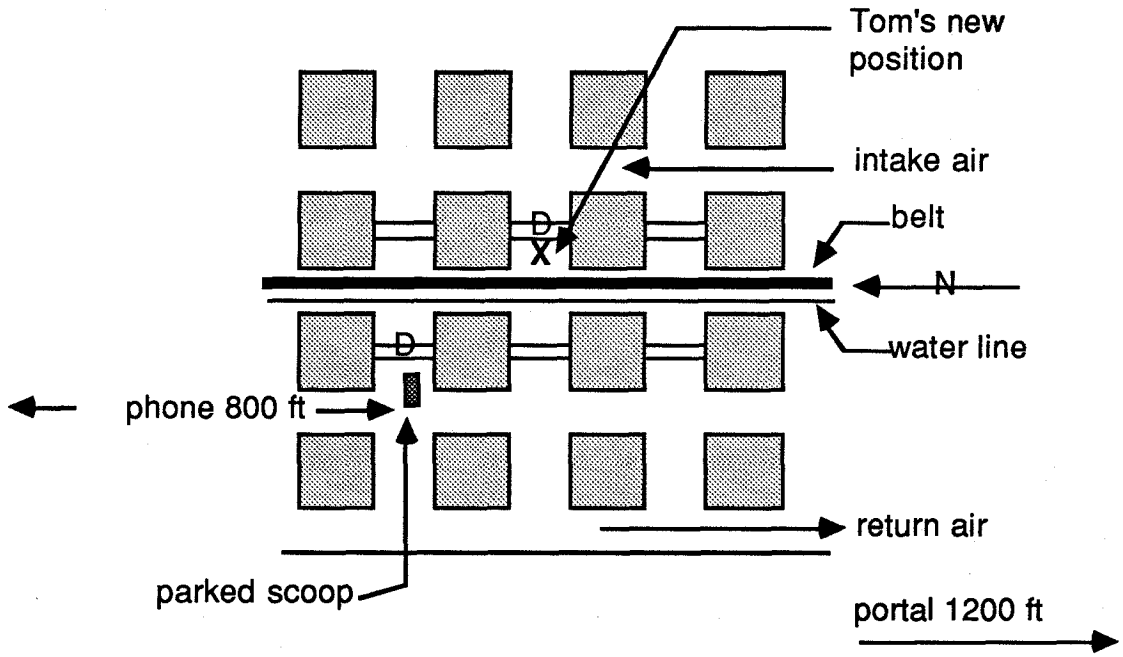

Figure 2: Portion of mine map showing Big Tom's new position

Question F

You leave Tom about two feet from the mandoor. You are so weak you can't drag him anymore. The mandoor is cool so you push it open into the intake air. A stream of fresh air blows in on you. You are too weak to pull Tom through the door. You barely pull yourself through. You collapse on the intake air side of the door, propping it open by leaning against it. Soon your self-rescuer cools and you take it off. The air smells fresh. You rest for a few moments. At this point it would be most important to:

21. Close the mandoor and go inby to the section to get help.

22. Close the mandoor, rest for a few moments, then go back into the belt entry and pull Tom out fast.

23. Leave the mandoor into the belt entry wide open, watch Tom, and wait for help.

24. Close the mandoor, then move outby in the intake air to get help.

Question G

What might have been a likely source of the carbon monoxide that overcame Tom?

25. An electrical cable fire on a roof bolter at the face.
26. Cutting into old works at the face.
27. A leaking seal from a bleeder entry around a gob area.
28. The slow combustion of coal dust on the mine floor around the belt.

Question H

Assume that there was 0.2% (two tenths of one percent) carbon monoxide in the air where Tom went down when he was fixing the water line. What can you predict about Tom's condition if he were to stay in this place for 60 minutes without protective breathing equipment?

29. He will be dead.

30. He will remain unconscious but recover in a few minutes once he is in fresh air.

31. Once he has some oxygen he will regain consciousness and be O.K. in an hour or two.

32. A 0.2% concentration of carbon monoxide might cause a headache, but it wouldn't put a healthy miner out.

Question I

In situations like this problem, which instrument would warn miners that a small (but dangerous) amount of carbon monoxide was present?

33. Flame safety lamp

34. Methane detector

35. Oxygen analyzer

36. None of the above

Question J

In quiet air that is not moving, where is carbon monoxide most likely to accumulate and why?

37. Near the mine floor because it is heavier than air.

38. Near the mine roof because it is lighter than air.

39. Near the source of the fire as the gas is produced.

40. Near the mine roof because it is heavier than air.

Scoring your performance

1. Count the total number of responses you colored in that were marked "correct". Write this number in the first blank on the answer sheet.

2. Count the total number of "incorrect" responses you colored in. Subtract this number from 30. Write the difference in the second blank on the answer sheet.

3. The best score is 40. The worst score is 0.

Appendix B: Answer Sheet Blanks

These are the answer sheet blanks. Copies of these blank answer sheets may be duplicated in the normal fashion. However, the answers that are found within the brackets must be printed on these blank answer sheets in invisible ink. These answers are found in Appendix C. If you have the capability to print invisible ink, make copies of the blank answer sheets. Make a master of the answers that appear in Appendix C. Then print the invisible ink on the blank answer sheets, being careful to make sure all pages print and that the appropriate answers line up with the appropriate blanks. The Master Answer Sheet shows all the answers in their proper places.

Most companies and trainers prefer to obtain copies of the preprinted answer sheets from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to lord-mary@msha.gov.

The exercise is designed to be used in small groups. You will need one answer sheet for each group of 3 to 5 persons in your class. The answer sheets are consumable. You will need a new set for each class.

A developing pen is also needed by each person who marks an answer sheet.

Master Answer Sheet for Water Line Repair

Use this answer sheet to mark your selections. Rub the developing pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you have made a selection. Otherwise you may not get the information you need. The last part of the message will tell you what to do next.

Question A (Choose only ONE unless you are told to "Try Again!")

1. [ ]

2. [ ]

3. [ ]

4. [ ]

Question B (Choose only ONE unless you are told to "Try Again!")

5. [ ]

6. [ ]

7. [ ]

8. [ ]

Question C (Choose only ONE unless you are told to "Try Again!")

9. [ ]

10. [ ]
    [ ]

11. [ ]

12. [ ]
    [ ]

Question D (Choose only ONE unless you are told to "Try Again!")

13. [ ]

14. [ ]
    [ ]

15. [ ]
    [ ]

16. [ ]

Question E (Choose only ONE unless you are told to "Try Again!")

17. [ ]

18. [ ]

19. [ ]

20. [ ]
    [ ]

Question F (Choose only ONE unless you are told to "Try Again!")

21. [ ]

22. [ ]
    [ ]

23. [ ]
    [ ]

24. [ ]

Question G (Choose only ONE unless you are told to "Try Again!")

25. [ ]
    [ ]

26. [ ]
    [ ]
    [ ]

27. [ ]
    [ ]
    [ ]

28. [ ]
    [ ]
    [ ]

Question H (Choose only ONE unless you are told to "Try Again!")

29. [ ]
    [ ]
    [ ]
    [ ]

30. [ ]
    [ ]
    [ ]

31. [ ]
    [ ]
    [ ]

32. [ ]
    [ ]

Question I (Choose only ONE unless you are told to "Try Again!")

33. [ ]
    [ ]
    [ ]

34. [ ]

35. [ ]
    [ ]
    [ ]

36. [ ]
    [ ]
    [ ]
    [ ]

Question J (Choose only ONE unless you are told to "Try Again!")

37. [ ]
    [ ]
    [ ]
    [ ]

38. [ ]
    [ ]

39. [ ]
    [ ]
    [ ]
    [ ]

40. [ ]
    [ ]

Finding your score

Number of "Correct" answers you colored in = (1)_____

30 minus number of incorrect answers you colored in = (2)_____

Add blanks one and two to get your total score = (3)_____

Highest possible score = 40

Lowest possible score = 0

Appendix C: Invisible ink Answers

These pages contain the answers that must be printed in the blanks of the answer sheet in Appendix B. These answers are spaced and sequenced correctly so that they exactly match up with the appropriate blanks on the answer sheet blank.

Once the answers have been printed in the answer sheet blanks, the developing pen reveals the formerly invisible printed message.

You may obtain preprinted answer sheets or you may prepare your own copies. To learn more about these options, and to determine how many answer sheets and developing pens you will need, see the introductory section of the Instructor's Copy.

You can't. You get weak and pass out after one crosscut. Try again!

You can't. You get weak and pass out after one crosscut. Try again!

Correct! Do the next question.

You pass out after giving Tom a few breaths. Try again!

Try again!

Try again!

Try again!

Correct! Do the next question.

Correct! This will alert others and bring help. Do the next question.

Can't. You have your FSR on. If you take it off you and Tom may both die. No one will know you are in trouble. Try again!

Would take too long. Tom will die. Try again!

Would waste time. You need to get Tom out of carbon monoxide fast if he is to live. Try again!

Too far. You are too weak. You collapse after one crosscut. Try again!

Correct! You have a chance to save Tom and yourself. Intake air is closer than return air and probably cleaner. Do the next question.

Would waste time. Tom is unconscious and can't keep the mouthpiece in. Carbon monoxide will still get into his lungs. Try again!

Too far! You are too weak. Return air could be bad too. Try again!

Would waste time and increase the risk to Tom and you. Try again!

Correct! You have a chance to save Tom and yourself! Do the next question.

Would take too long. Tom will die and you may too. Try again!

SCSRs too far away. Tom will die and you may not get to the scoop. Anyway, Tom is unconscious and can't breathe through the unit. Try again!

Tom would die. You are too weak to travel. Try again!

Tom would die. You are too weak to get Tom out. You can't move fast. Try again!

Correct! Fresh intake air will blow over and protect Tom. You can watch and signal for help. Do next question.

Tom would die. You are too weak to travel. Try again!

Not likely. A cable fire at the face would produce smoke. Fumes would be swept out the return air. Try again!

Not likely. Old works produce oxygen deficient air (blackdamp) containing carbon dioxide. Anyway, gases at the face would be swept out the return air. Try again!

Not likely. Bleeders usually contain methane. Carbon monoxide is not likely unless there was a fire in the gob. Anyway, gases from the gob would not likely be present in the neutral air of the belt entry. Try again!

Correct! Coal on the floor by the belt can be ignited by a hot roller bearing. The coal dust can burn without smoke or flame for several hours or days and produce deadly levels of carbon monoxide. Do the next question.

Correct! The 15 minute threshold limit value (TLV) for carbon monoxide is 0.04 percent (1/25 of = percent). Here the concentration is 1/5 of <u>one</u> percent, or 5 times greater. This will produce unconsciousness in 30 minutes and death in less than one hour. Do the next question.

Even if he lives, recovery will take hours. Blood has 300 times greater attraction for carbon monoxide than for oxygen. Even a tiny amount of this gas in the air prevents the blood from taking on oxygen. Try again!

Even if he lives, recovery will take hours. Blood has 300 times greater attraction for carbon monoxide than for oxygen. Even a tiny amount of this gas in the air prevents the blood from taking on oxygen. Try again!

This much will make even the strongest person unconscious in less than 30 minutes. Try again!

The flame safety lamp would appear normal. Oxygen in the air would be decreased hardly at all. Yet carbon monoxide would be present in a tiny but deadly amount. Try again!

Methane detectors don't measure carbon monoxide. Try again!

Oxygen analyzers are more accurate than flame safety lamps. But in this situation the oxygen reduction is so small the analyzer will give a normal reading. Yet the tiny amount of carbon monoxide may be fatal. Try again!

Correct! The best detector among those listed is you! The smell of coal burning, your knowledge of mine gases, what happened to Tom, your headache, nausea, and weakness should all lead you to suspect carbon monoxide. Do the next question.

Try again!

Try again!

Correct! Carbon monoxide is almost the same weight as air. It has no preference for top or bottom, although in hot smoke it rises to the top with the hot air. By itself it is odorless and colorless. In quiet air it collects near the material that is burning. END OF PROBLEM.

If heavier, it would collect near the mine floor. Try again!