

Main Haulage Scaling Exercise

Instructor's Copy

Mining Systems and Human Engineering
U. S. Bureau of Mines
Pittsburgh, Pennsylvania

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Appendix C: Invisible ink answers (print these on the answer sheet blanks)

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 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 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.¹ Answer sheets are consumable. One is needed for each small group of 3 to 5 persons who work the exercise. Also included with this instructor's copy is a 3-D slide reel. A reel of 3-D slides and a View-Master² viewer³ is necessary for each person working 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.

<u>Type:</u>	Invisible ink
<u>Audience:</u>	Underground coal miners
<u>Length:</u>	Fourteen questions (40 minutes for administration plus 20 for discussion)
<u>Objectives:</u>	Recognize and appreciate the input of others with more experience or knowledge of conditions in the work area Recognize and assess the clues indicative of hazardous work conditions Anticipate and recognize the importance of location to roof control (main line haulage must be kept in compliance) Evaluate the information and alternatives available to remedy roof hazards Select the appropriate course of action to remedy the roof control problem Establish and order the priorities and procedures necessary to safely restore roof control compliance Recognize and identify safe barring practices Recognize and identify unsafe barring practices Assess and comprehend the necessity of working only around de-energized trolley wire Recognize and perform the appropriate measures to de-energize and restore power to the trolley wire Recognize and identify a non-compliance condition of the roof control plan
<u>Location:</u>	Underground coal mine section, 80 inch seam height

¹You 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.

² Reference to specific products does not imply endorsement by the Bureau of Mines.

³ These may be purchased from your local toy store or purchased directly from Fisher-Price, Inc., Viewmaster Custom Sales, Customer Service, 636 Girard Ave., East Aurora, NY 14052, (716) 687-3899.

Problem: You are running the lead locomotive pulling twenty empty coal cars into 3 East. Lynnbo is running the trail locomotive behind the trip. When you are done putting the empties on the section tippie, Lynnbo asks if you noticed the area of bad roof outby the firecar on the main line. You answer that you hadn't, and you ask Lynnbo how bad it looked. Lynnbo said he thought that the roof looked ugly to him, but since he works in the shop, it all looks ugly. This is your section and you know it has been recently rebolted. However, you decide to look at it. You tell Lynnbo that you will follow him to the area in question. You must decide the safest course of action in determining if there is a problem, then you must decide the safest course of action to take in fixing, or having the bad roof fixed.

How to Use This Exercise

1. Look at the performance objectives. Decide if the exercise is relevant for your training.
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 you can present it to your class without reading it. Put the figures 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, a 3-D slide reel, and a 3-D viewer to each person and an answer sheet and a developing pen to each group of 3 to 5 persons.
 - Demonstrate how to select and mark answers using the developing pen, and how to use the 3-D slide reel and viewer.
 - Go over the instructions for working 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 compute 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. Refer to the Instructor's Discussion Notes and add your own ideas.

Master Answer Sheet for the Main Haulage Scaling Exercise

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.

Question A (Select as MANY as you think are correct.)

1. [Correct! The absence of rock dust on the roof may be an indication that the]
[that the roof is working.]
2. [Correct! The area was rebolted, but it is a good idea to investigate anytime]
[see a hanging bolt. According to 30CFR Part 75.1403-10(c), the bolt]
[must be marked by reflective signs or tape or warning lights of there is an]
[abrupt or sudden change of overhead conditions.]
3. [Rusty bolt plates are signs of oxidation and normally do not indicate a hazard.]
4. [Correct! Fresh roof rubble on the bottom could indicate a roof problem.]
5. [Correct! The area was rebolted, but the chandelier could be an indication of]
[a problem. Also, according to 30CFR Part 75.1403-10(c), the bolt must be]
[marked by reflective signs or tape or warning lights if there is an abrupt or]
[sudden change of overhead conditions.]

Question B (Select as MANY as you think are correct.)

6. [Correct! There is always potential for injury when material falls from a clay]
[vein.]
7. [Regardless of the number, bolts through a clay vein are not recommended]
[for supporting the roof.]
8. [Bolt type can't be identified from this slide.]
[]
9. [Correct! The use of headers would provide additional support. The roof bolts]
[through the clay vein most likely provide very little support.]

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

- 10. [You may want to do this at a later time, but you should do something else first.]
[Try again!]
- 11. [Setting temporary posts could become necessary, but you must do something]
[else first. Try again!]
- 12. [This action is not necessary at this time. Try again!]
- 13. [Correct! The loose hanging roof rock must be pulled down first. Do the next]
[question.]

Question D (Select as MANY as you think are correct.)

- 14. [Correct! Advise the foreman of the situation and tell him what corrective]
[actions you want to take.]
- 15. [Correct! It is doubtful that you will have all the necessary tools but you might]
[have some of them. This will give you an idea of what additional tools are]
[needed.]
- 16. [Although it would be good to have transportation outby the area to be scaled,]
[nobody should be subjected to any additional danger by traveling under the]
[identified roof condition.]
- 17. [Correct! The dispatcher should always know what is happening on haulage]
[roads.]
- 18. [Experienced miners should be able to decide if loose top needs to be scaled]
[down, at least for their own safety.]
- 19. [The proper tools for the job should always be used, not just what is on hand.]
- 20. [Correct! You should never abandon a piece of equipment on the main]
[haulage. One person should stay behind.]

Question E (Select as MANY as you think are correct.)

- 21. [Correct! The area above, below, behind, beside and ahead should be examined to assess the full extent of the condition.]
- 22. [Correct! Sounding the roof is always an appropriate action to determine how extensive the separation problem is. The bad roof condition could extend beyond the noticeable area.]
- 23. [Correct! A safe working plan can eliminate the potential for injury when scaling roof.]
- 24. [Correct! A safe footing area must be established.]
- 25. [Correct! You can eliminate the potential for electrocution by using the wire guards from your locomotives. However, as with any safety equipment, they are useless if they are not used, or are not used properly.]
- 26. [This isn't necessary because it will not change the roof condition.]
- 27. [You don't know this yet.]

Question F (Select as MANY as you think are correct.)

- 28. [Correct! These are important concerns for safe barring work.]
- 29. [This action is not necessary at this time, since you are working in the area.]
- 30. [Excessive body movements could cause you to lose control of the bar and be]
[injured. You could also lose your balance and fall under the bad top.]
- 31. [Correct! Gloves can provide protection to hands and also improve your grip.]
[Wearing safety glasses is a must when performing any work task.]
- 32. [You could lose control of the bar by picking or jabbing and injure yourself]
[and/or others.]
- 33. [You should stop occasionally, step back, and look at the roof to be sure that]
[conditions have not been made worse by your actions. Besides, it is a good]
[idea to stop and rest periodically to avoid becoming exhausted.]
- 34. [Correct! Overhead barring is very strenuous. People who aren't used to that]
[activity can easily become arm weary and endanger themselves and others.]
- 35. [Correct! Solid footing is very important for safety, not only for you, but also]
[for others working nearby.]
- 36. [This is not a barring practice. Rockdust is not a concern at this time.]

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

- 37. [You should do something else before knocking the power. Try again!]
- 38. [This is dangerous. This action places the workers too close to the energized]
[trolley wire. Try again!]
- 39. [Correct! The dispatcher must be informed of any temporary loss of power.]
[He will then inform other employees inby the outage and get back with you.]
[Do the next question.]

Question H (Select as MANY as you think are correct.)

40. [This is not necessary. In addition, you and Lynnbo are not trained wiremen.]
41. [Correct! This is an important step. The locomotive will not be able to]
[maintain air to the braking system after the power is off.]
42. [Do not rely on the lights going off on the locomotives to tell you that the wire is]
[de-energized. Many locomotives have a battery system for their light control.]
[Their lights would not go off in that situation. It is best to wait for Lynnbo to]
[come and tell you the power is off.]
43. [Correct! Lynnbo should not only knock the power but he must lockout and]
[danger tag the switch. Lynnbo must also block access to the trolley switch]
[from other vehicles. Any vehicle that crosses the trolley wire switch could]
[send power inby. Access can be denied by placing a board or some other]
[non-conductive material from the trolley switch guard boards to the opposite]
[side rail.]

Question I (Select as MANY as you think are correct.)

44. [Not yet. There are things that need to be done before energizing the trolley]
[wire.]
45. [Correct! You cannot assume that other people or equipment are not in]
[contact with the wire somewhere else in the mine.]
46. [The person who turns off the power should be the one to turn it back on. This]
[procedure can eliminate the danger of another worker being accidentally]
[electrocuted.]
47. [Correct! Compliance with the roof control plan could now be a problem]
[depending upon how much roof material has been taken down.]

Question J (Select as MANY as you think are correct.)

- 48. [Correct! The "fire boss" found the area to be safe at the time of his inspection.]
[However, conditions do change and hazards can develop anytime after the]
[examination.]
- 49. [Correct! However, you should be able to take the initiative when it is a small]
[job. Your extra effort could save someone from an injury.]
- 50. [Correct! Even though a hazardous condition may not affect you now, it could]
[be dangerous to you or others later.]
- 51. [Correct! Inspectors and foremen are responsible for safety but they can't see]
[every hazard. They need your help.]
- 52. [Correct! But good housekeeping and a little effort can sometimes prevent a]
[small problem from developing into a major one.]

Question K (Select as MANY as you think are correct.)

- 53. [Correct! Because his bar is too short, he is standing directly under bad roof.]
- 54. [Correct! Bad footing is potentially hazardous.]
- 55. [Correct! This should be done before you start.]

Question L (Select as MANY as you think are correct.)

- 56. [Correct! They are standing directly under bad roof.]
- 57. [Correct! Bad footing is potentially hazardous.]
- 58. [Correct! Bars are designed to be used by just one person. If enough force]
[cannot be applied by one person, additional leverage can be provided by]
[extending the bar with a section of pipe.]
- 59. [They have taken the proper step of guarding the wire.]

Question M (Select as MANY as you think are correct.)

60. [Correct! Safety glasses should be worn to protect him from a serious eye]
[injury.]
61. [Correct! The short bar puts you in danger by forcing you to work too close to]
[the bad area.]
62. [Correct! Trolley wire guard that is too short for the work area is unsafe to use.]
63. [Correct! He could drop his bar on you, or pull loose rock down on top of you.]

Question N (Select as MANY as you think are correct.)

64. [Correct!]
65. [Correct!]
66. [Correct! A bent bar can throw the miner off balance and should not be used.]
67. [Correct! The miner is standing beneath good bolts.]
68. [Correct! The bar is long enough that his hands are not above his shoulders.]
69. [You can't determine this because his feet can't be seen in this slide.]

Finding your score

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

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

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

Highest possible score = 69

Lowest possible score = 0

Instructor's Discussion Notes for Main Haulage Scaling

Use the information presented here and on the master answer sheet, your own ideas and experience, and those of the miners in your class, to discuss the exercise after it is completed. Group discussion can 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 miners think about and remember basic knowledge and skills they may someday need to deal with an emergency. The discussion following the exercise can contribute to this goal and tailor the exercise content to the needs of the group you are training.

It is helpful to show overhead transparencies of the master answer sheet during the discussion while the miners look at their problem booklets. 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 provide additional information for you to discuss 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 - The correct answers are 1, 2, 4 and 5. The layer of roof that was covered by rock dust has obviously fallen away (1), indicating certain roof activity. This could be the result of a minor local occurrence or an indication of possibly a more considerable failure. Likewise, roof coal littering the bottom (4) is a good indicator of localized roof activity. The loose hanging roof bolts (2) and chandeliers (5) are evidence the roof has fallen in the past. Because the area was rebolted the roof should be structurally sound, however the immediate roof coal, shale and slate could continue to fall. Additionally the chandeliers and loose pins can be potentially hazardous to miners walking near them. Rusty roof bolt plates (3) in this situation are not evidence of a potential roof hazard, just normal oxidation.

Question B - The correct answers are 6 and 9. The area of roof rock surrounding a clay vein (6) should always be considered potentially hazardous, particularly the coal between the immediate roof and the clay vein (8). Even though there is a difference between the heads of resin and expansion roof bolts, at the distance of the slide, a distinction cannot be made. Bolts through a clay vein offer little or no support for the clay vein. The best way to support such structure is to bolt header boards into solid roof along the lip of the clay vein (9). Because of an unknown anchor area, as well as the soft nature of clay, bolting directly into a clay vein (7) is bad business. This is an important point to note. Over 75% of the field test subjects chose this as a correct answer. This shows a broad misunderstanding of how to properly support clay veins. The depth of the vein could be greater than the length of the roof bolt. **It needs to be stressed** that the proper way to support the lip of a clay vein

(9) is bolting along the edge of the clay vein using bolts with wooden planks attached. The bolts can be anchored into solid material and the header boards can support the interface of clay and coal.

Question C - The only correct answer is 13. The loose (13) roof must be barred down before it falls and causes an accident. Resin bolts cannot be tightened, and expansion bolts can't be tightened (10) to meet roof control plan specifications without the use of a torque wrench. This could involve standing under bad top. Setting posts (11) and roof bolting (12) might become necessary, but at this time there is a more immediate hazard.

Question D - Answers 14, 15, 17, and 20 are correct. The shift foreman is responsible for operating the coal mine and he should be informed (14) of any and all unexpected or unconventional occurrences. Besides, he might be able to offer some knowledge or advice unknown to the miners. By establishing what tools you already have (15), you will probably hasten your tool search. To coordinate traffic, the dispatcher (17) must be aware of all activities and the locations of personnel on track haulage ways. One person should stay in the area (20) for safety reasons rather than both employees going to look for tools. Some good reasons to have a locomotive outby the noted area of concern (16) are: transportation is available in case of accident or injury, the vehicle can deny access to the area, and a vehicle is available to the employees to leave when necessary. Having listed these reasons, none are valid or can excuse traveling under an identified bad roof condition. Experienced miners make assessments and judgments about mine conditions continually. Roof control situations are no different. Miners should be able to identify conditions that can be fixed by scaling from conditions that would need the attention of roof control specialists (18). Using the wrong tool (19) is as dangerous as using a tool the wrong way. Both can lead to accident and injury.

Question E - The correct answers are 21, 22, 23, 24, and 25. A detailed examination, not only by sight but also "listening" to a hazardous area, might reveal evidence of the roof settling and shifting (21). Sounding the roof (22) is always prudent to establish size and severity of the hazardous roof area. There can be several ways (23) to do most work activities (SOP's), however, all participants must be aware of the actions of fellow employees to avoid accidents and needless complications. A well thought out work plan can accomplish this goal. Removing stumbling hazards (24) and guarding the trolley wire (25) with non-conductive guards (30 CFR 75, Sec 75-1003) are both good examples of devising and using a safe work plan. Blowing the dust around (26) will not remove any hazards and might temporarily hamper your vision. With the available information, a decision cannot be made at this time about future empty deliveries (27). That decision should be made by the dispatcher or shift foreman.

Question F - The correct answers to this question are 28, 31, 34, and 35. When scaling with too short of a bar (28), the user might be too close to the barring area. A scaling bar should be straightened when necessary. Using a bent bar can cause the scaler to lose his/her balance. The requirement to wear eye protection underground (31) while doing all work is not specifically stated in 30CFR Part 75, subpart R sec.75.1720. However most

mining companies stipulate that as policy. Since barring isn't part of most miners' daily routine, muscles unaccustomed to this activity can fatigue very quickly. Taking occasional breaks (34) can lessen this fatigue and reduce the potential for human error. Standing on loose material (35) creates a tripping or falling hazard. Also, if the person scaling needs to climb onto something to reach the roof, a longer bar could be used. If the miners were going to leave this area unattended (before it was made safe) it would be necessary to physically deny access to others or danger-off this area (29) (30CFR 5 - 7 subpart B sec. 57.3200). A slate or scaling bar is the proper tool for barring roof. This tool was designed to be sturdy enough to provide leverage as a prying force between loose material and the solid base. If more force is needed, a longer bar should be used. Never bounce on the bar (30). Improper use of this tool (i.e. picking, thrusting, stabbing, etc.) (32) can cause the user to lose his grip on the bar. A flying or bouncing bar could injure the user or others. A continuous assessment of roof conditions should be of primary concern to miners when barring down hazardous roof. Occasionally stepping back for a more detailed look (33) at the area will help evaluate progress and detect new problems. Rock dusting (36) is important, but isn't a barring practice and can be done at a later time.

Question G - The correct answer is 39. Working under a hot trolley wire is dangerous, since accidental contact with the 550 volt current can kill instantly. But if a piece of roof fell and broke the live wire, it's swinging wild path could pose additional safety concerns. (38) De-energizing the wire (37) can save the miners from electrocution, but neglecting to notify employees who might be using DC power inby could cause an accident. When possible, before knocking any power source (39) you should always contact anyone who might be affected. For example, mechanics repairing machinery might need the power to stay on while positioning equipment or parts. Another group of people needing to be warned before de-energizing power is haulage vehicle operators (locomotives, jeeps mantrips, etc.).

Question H - Answers 41 and 43 are correct. Only in an emergency situation should qualified wiremen, equipped with the proper tools, cut an energized trolley wire (40). Both locomotives are inby the roof in question. It would not be wise to expose Lynnbo to additional roof hazard by running a locomotive under it. Walking would be much safer.(43) Not only should Lynnbo knock the power, he must follow lock out and danger tag procedures to avoid accidental electrocution. After the compressor can no longer apply the necessary air to the braking system, the locomotives could become a hazard to the miners by drifting into their work area, therefore mechanical brakes should be applied and the wheels blocked (41). Relying on the lights of the locomotive going off is not a good way to inform someone that power was cut to the trolley line.(42). **The instructor should stress** the importance of not relying on locomotive lights for determining if power is on or off. Many locomotives have battery powered backup systems which also operate the lights. When possible, verbal signals are the best way to communicate. Face to face communication is always the most effective.

Question I - The correct answers are 45 and 47. If the miners would leave now (44), cleanup and roof control could still be a problem. Employees might be working on or around DC powered equipment and must be notified before the power is restored. Proceeding without notification could lead to an accident causing injuries or equipment damage. In this situation the dispatcher should notify employees (45). At mine sites without a dispatcher, perhaps the foreman or the person who de-energized the power should notify people inby that the power will be restored. Locking out the trolley switch should prevent the foreman from energizing the trolley line (46). A universal practice when working with electricity is that the person who will be exposed to an electrical hazard should be the only one to energize and de-energize the device. Depending on the amount of material barred down, some of the roof bolts might no longer be in contact with the roof. Roof support might be needed to comply to the roof control plan. Depending on how recently this area was developed, the area in question might not be under the current roof control plan (47). Roof support must comply with the plan under which it was developed.

Question J - All are correct answers and can be reasonably justified in the employee's mind. Most miners have overlooked or failed to report some safety concern at some time. Perhaps the employee was too busy with his own work assignments, thought that if he reported a safety hazard that he might be assigned by the foreman to remedy the condition, or judged the safety hazard not to be severe enough to warrant attention. **It must be pointed out** that safety is everyone's responsibility, not just that of the mine examiner, management or government inspector. They can miss spotting a hazard the same as anyone else. It is impossible for inspectors or even foremen to be able to continuously monitor conditions throughout the entire section.

Question K - All of the answers are correct. The miner is standing directly under the roof to be barred (53) and could pull the roof down on himself. The miner standing on a pile of debris (54) has greatly increased his chance of injury by either failing or slipping into the hazardous area. The metal scaling bar coming into contact with a 550 volt trolley wire (55) is a recipe for a fatality.

Question L - The correct answers are 56, 57, and 58. Using a scaling bar is a one person job (58). The coordination necessary to prevent two people from injuring each other when both are using the same bar may not be worth the effort. If more leverage is needed, use a longer bar. The guard on the wire is in place (59).

Question M - All responses are correct. Safety glasses can only protect your eyes (60) if they are worn. When possible, the trolley wire should be de-energized before miners attempt to bar down loose roof. When de-energizing trolley wire, remind miners that proper lockout/tagout procedures should be followed; however, if they must work with a hot trolley wire, the wire must be properly guarded and the guard must sufficiently cover the area of exposure (62). Using proper tools (61), and a well designed plan of attack could eliminate many of the dangers, such as barring roof down on your buddy (63).

Question N - The correct answers are 64, 65, 66, 67, and 68. It is uncertain if the miner is standing on solid bottom (69). The slide doesn't show his feet. Safety glasses (64), gloves (65), a straight bar (66), working under supported roof (67), and good posture (68) are all very important safety practices to use when scaling mine roof. These good practices need to be reinforced often.

References

Cassidy, S.M., Elements of Practical Coal Mining, AIME, 1973, Chapter 5.

Code of Federal Regulations, Title 30, Part 75, Office of Federal Register, 1993.

Holmes Safety Association Bulletin, Safe Scaling Guidelines, Dec., 1989, p 21.

Holmes Safety Association Bulletin, Safe Barring Guidelines, Dec., 1989, pp 19-20.

Scoring Key for Main Haulage Scaling

The correct answers are marked with an asterisk.⁴

<u>Question</u>	<u>Answer Number</u>						
A	1*	2*	3	4*	5*		
B	6*	7	8	9*			
C	10	11	12	13*			
D	14*	15*	16	17*	18	19	20*
E	21*	22*	23*	24*	25*	26	27
F	28*	29	30	31*	32		
	33	34*	35*	36			
G	37	38	39*				
H	40	41*	42	43*			
I	44	45*	46	47*			
J	48*	49*	50*	51*	52*		
K	53*	54*	55*				
L	56*	57*	58*	59			
M	60*	61*	62*	63*			
N	64*	65*	66*	67*	68*	69	

⁴This page may be duplicated 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 NIOSH, Pittsburgh Research Laboratory, Pittsburgh, PA phone 412-386-5901, fax 412-386-5902 or email to minetraining@cdc.gov.

Main Haulage Scaling Exercise
Problem Booklet

Mining Systems and Human Engineering
U. S. Bureau of Mines
Pittsburgh, Pennsylvania

Instructions

Read the background and problem situation described on the next page. Then answer each of the fourteen questions. Some questions will ask you to look at a slide. Look at the appropriate slide, then continue on with the question. Don't jump ahead, but look only at the question and slide to which you are directed. However, you may look back to earlier questions, answers, or slides at any time. Some questions ask you to select as MANY answers as you think are correct. Other questions ask you to select only ONE answer unless you are told to try again. Follow the directions for each question.

After you have made your choice for a question, look up its number on the answer sheet. Select your answer(s) to each question by rubbing the special pen between the brackets on the answer sheet. Be sure to fill in the entire bracket space because it may contain important information to help you complete the exercise. A hidden message will appear and tell you if you are right. When you have finished all of the questions, you will learn how to score your performance.

Background

You are a swing shift locomotive operator at the Shannon Kelly Mine No. 3.

You have nine years of underground mining experience and have been running a locomotive for 7 years.

Lynnbo is a shop mechanic substituting for an absent motorman. He has 4 years of underground experience, all as a mechanic.

Roof conditions are generally good, with occasional slips and clay veins.

The Shannon Kelly Mine No. 3 has an 80 inch coal seam.

Power for the locomotives is provided by a 550 volt trolley wire.

The mine uses 37 ton locomotives equipped with compressor air braking systems and portable non-conductive trolley guards.

Problem

You are running the lead locomotive pulling twenty empty coal cars into 3 East. Lynnbo is running the trail locomotive behind the trip. When you are done putting the empties on the section tibble, Lynnbo asks if you noticed the area of bad roof outby the firecar on the main line. You answer that you hadn't, and you ask Lynnbo how bad it looked. Lynnbo said he thought the roof looked ugly to him, but since he works in the shop, it all looks ugly. This is your section and you know it has been rebolted recently. However, you decide to look at it. You tell Lynnbo that you will follow him to the area in question. Turn the page and answer Question A.

Question A

Arriving at the area of suspected bad roof, you stop both motors inby the area in question. This is what you and Lynnbo see (Look at Slide 1). Even though the roof has been rebolted, there are some indications that this could be an area of bad top. What do you see to confirm this? (Select as MANY as you think are correct.)

1. Absence of rock dust on the roof.
2. A loose, hanging roof bolt.
3. Rusty bolt plates.
4. Loose coal and rock between the tracks.
5. Roof rock fallen away from a bolt (sometimes called a "chandelier").

When you have made your selection(s) do the next question.

Question B

Because this section of questionable roof is on the main line, you decide to make a more detailed examination of the area to get a better idea of the extent of the problem. You look at the area more closely and from a slightly different angle and direction. (Look at Slide 2.) What potentially hazardous conditions can you see now? (Select as MANY as you think are correct.)

6. A crumbling clay vein.
7. An insufficient number of bolts through the clay vein.
8. Expansion-shell bolts used in place of resin bolts.
9. Lack of header boards along the lip of the clay vein.

When you have made your selection(s) do the next question.

Question C

After examining the roof area further, you see that there is a gap in the roof. (Look at Slide 3.) This slide shows a close up of one small area (taken with a zoom lens). What should you and Lynnbo do first? (Choose only ONE unless you are told to "Try Again!")

10. Tighten any loose roof bolts.
11. Set posts across the track.
12. Call outside for roofbolters.
13. Take down loose top.

Question D

You and Lynnbo agree that some of the loose roof should be taken down. What should you do before you start scaling? (Select as MANY as you think are correct.)

14. Call the shift foreman to brief him about the situation.
15. Even though you don't normally carry all barring tools on the locomotive, check to see what you have.
16. Run one locomotive outby to block the access to the bad roof area.
17. Call the dispatcher and advise him of the problem.
18. Nothing. You are not roof control specialists.
19. Begin prying the top with the tools on hand.
20. Send Lynnbo on your inby locomotive to the 3 East section tipple to find slate bars, shovels, etc. while you stay with the other locomotive.

When you have made your selection(s) do the next question.

Question E

When you talked to the foreman, he told you to proceed with barring the roof, but he wants to be kept informed of the situation. Lynnbo then takes your locomotive and heads for the tipple. He returns with a shovel, slate bars and a sledge hammer. What should be done before you begin to bar the roof? (Select as MANY as you think are correct.)

21. Observe and "listen" to the area from a safe distance.
22. Sound the roof that surrounds the bad top.
23. Devise a plan for working on this problem safely.
24. Remove any stumbling hazards from your work area.
25. Guard the trolley wire next to the work area.
26. Using the compressors from your locomotives, blow the dust off the track and the surrounding area.
27. Call the 3 East tipple operator and tell him that there won't be any more empties today.

When you have made your selection(s) do the next question.

Question F

You and Lynnbo are now ready to begin barring. Lynnbo grabs the shovel and begins to pry the roof. You stop Lynnbo and tell him to use a slate bar instead of the shovel. What other safe barring practices should you tell Lynnbo to use? (Select as MANY as you think are correct.)

- 28. Check to make sure the bar is long enough and is straight.
- 29. Cordon off the work area with reflective tape.
- 30. Bounce on the bar as you need to exert more force.
- 31. Wear safety glasses and gloves.
- 32. Jab at the roof with the pointed end of the bar to knock down pieces of roof material.
- 33. Continue scaling without stopping, until the roof is safe.
- 34. Take occasional breaks.
- 35. Stand on solid bottom while you scale, not on loose rubble or wooden cribs.
- 36. Rockdust any newly exposed roof.

When you have made your selection(s) do the next question.

Question G

You and Lynnbo continue to scale the roof. You notice a large piece of rock hanging above the trolley wire. You must pull it down, but working around an energized cable is dangerous and the falling rock could damage the trolley wire. You know there is a trolley wire disconnect switch about six hundred feet outby. What should you do about this situation before you scale down the loose rock? (Choose only ONE unless you are told to "Try Again!")

- 37. De-energize the trolley wire.
- 38. Nothing. Start to bar down the rock as soon as possible.
- 39. Inform the dispatcher that you are going to de-energize the trolley wire.

Question H

The dispatcher gave you the OK to de-energize the trolley line. You called the foreman to tell him of your plans. He tells you to go ahead and reminds you that there are no segregation switches inby you. What should you do now? (Select as MANY as you think are correct.)

- 40. Cut the trolley wire.
- 41. Block the wheels of the locomotive and apply the mechanical brakes.
- 42. Leave the locomotive trolley poles on the wire, the lights switched to the "on" position. The lights of the locomotive will go off as a test that the trolley line is de-energized.
- 43. Ask Lynnbo to walk outby to the trolley switch, knock out the blade of the switch and return.

When you have made your selection(s) do the next question.

Question I

After having de-energized and dangered off the trolley switch, you and Lynnbo successfully scaled down the rock above the trolley wire. You are satisfied that all of the loose roof above the trolley wire is down. What should you do before turning on the power? (Select as MANY as you think are correct.)

- 44. Nothing. Turn on the power now and then proceed to the tibble with Lynnbo.
- 45. Have the dispatcher inquire whether it is safe to energize the trolley wire.
- 46. Call the foreman and ask him to turn the power on when he comes in.
- 47. Examine the roof to be sure it is still in compliance with the original approved roof control plan for this area of the mine.

When you have made your selection(s) do the next question.

Question J

The power is now on and you have returned to work at your usual duties. Later, the foreman thanks you and Lynnbo for your concern over an important safety issue. Miners should take some action when they observe any potentially dangerous conditions. What are some common reasons why some workers do not take similar action when they see roof conditions like these? (Select as MANY as you think are correct.)

- 48. The mine examiner has examined the area for hazards and they think his initials certify that he has found the area to be safe.
- 49. They feel it is not their responsibility. The foreman should tell them what to do.
- 50. They feel the hazardous condition may be something they could work around and doesn't affect them.
- 51. They believe government inspectors and management officials are the only ones responsible for the safety of the mine.
- 52. They believe the hazardous condition isn't too severe.

When you have made your selection(s) do the next question.

Question K

It is important to use safe barring practices at all times and to concentrate on the task at hand. (Look at Slide 4.) What unsafe barring practices are being used by this miner ? (Select as MANY as you think are correct.)

- 53. He is standing too close to the area being barred.
- 54. He is standing on floor rubble.
- 55. He didn't guard the trolley wire before starting.

When you have made your selection(s) do the next question.

Question L

(Look at Slide 5.) What unsafe barring practices are being used by these workers?
(Select as MANY as you think are correct.)

- 56. They are standing too close to the area being barred.
- 57. They are standing on floor rubble.
- 58. More than one person is on the bar.
- 59. They are working near an unguarded trolley wire.

When you have made your selection(s) do the next question.

Question M

Here is another situation where two miners are barring down bad top. (Look at Slide 6.) What unsafe barring practices are being used here? (Select as MANY as you think are correct.)

- 60. One miner is not wearing safety glasses.
- 61. One miner is not using the proper length bar.
- 62. The guard on the trolley wire isn't long enough to protect both miners.
- 63. One miner is barring roof that is directly over his buddy.

When you have made your selection(s) do the next question.

Question N

The safe practices that apply to roof scaling can also be used for taking down loose rib. (Look at Slide 7.) What safe scaling techniques is this miner practicing? (Select as MANY as you think are correct.)

- 64. He is wearing safety glasses.
- 65. He is wearing gloves.
- 66. He is using a straight scaling bar.
- 67. He is working under supported roof.
- 68. He is using good barring posture.
- 69. He is standing on solid bottom.

End of Problem

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 24. Write the difference in the second blank on the answer sheet.
3. The best score is 69. 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 NIOSH, Pittsburgh Research Laboratory, Pittsburgh, PA phone 412-386-5901, fax 412-386-5902 or email to minetraining@cdc.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. These may be obtained from the A. B. Dick Company, P.O. Box 1970, Rochester, New York 14692, phone 1-800-225-4835.

Answer Sheet for Main Haulage Scaling

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.

Question A (Select as MANY as you think are correct.)

- 1. []
[]
- 2. []
[]
[]
[]
- 3. []
- 4. []
- 5. []
[]
[]
[]

Question B (Select as MANY as you think are correct.)

- 6. []
[]
- 7. []
[]
- 8. []
[]
- 9. []
[]

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

10. []
[]

11. []
[]

12. []

13. []
[]

Question D (Select as MANY as you think are correct.)

14. []
[]

15. []
[]
[]

16. []
[]
[]

17. []
[]

18. []
[]

19. []

20. []
[]

Question E (Select as MANY as you think are correct.)

- 21. []
[]
- 22. []
[]
[]
- 23. []
[]
- 24. []
- 25. []
[]
[]
- 26. []
[]
- 27. []

Question F (Select as MANY as you think are correct.)

- 28. []
- 29. []
- 30. []
[]
- 31. []
[]
- 32. []
[]
- 33. []
[]
[]
- 34. []
[]
- 35. []
[]
- 36. []

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

- 37. []
- 38. []
[]
- 39. []
[]
[]

Question H (Select as MANY as you think are correct.)

- 40. []
- 41. []
[]
- 42. []
[]
[]
[]
- 43. []
[]
[]
[]
[]
[]

Question I (Select as MANY as you think are correct.)

- 44. []
[]
- 45. []
[]
- 46. []
[]
[]
- 47. []
[]

Question J (Select as MANY as you think are correct.)

48. []
[]
[]

49. []
[]

50. []
[]

51. []
[]

52. []
[]

Question K (Select as MANY as you think are correct.)

53. []

54. []

55. []

Question L (Select as MANY as you think are correct.)

56. []

57. []

58. []
[]
[]

59. []

Question M (Select as MANY as you think are correct.)

60. []
[]

61. []
[]

62. []

63. []

Question N (Select as MANY as you think are correct.)

64. []

65. []

66. []

67. []

68. []

69. []

Finding your score

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

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

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

Highest possible score = 69

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.

Correct! The absence of rock dust on the roof may be an indication that the that the roof is working.

Correct! The area was rebolted, but it is a good idea to investigate anytime see a hanging bolt. According to 30CFR Part 75.1403-10(c), the bolt must be marked by reflective signs or tape or warning lights of there is an abrupt or sudden change of overhead conditions.

Rusty bolt plates are signs of oxidation and normally do not indicate a hazard.

Correct! Fresh roof rubble on the bottom could indicate a roof problem.

Correct! The area was rebolted, but the chandelier could be an indication of a problem. Also, according to 30CFR Part 75.1403-10(c), the bolt must be marked by reflective signs or tape or warning lights if there is an abrupt or sudden change of overhead conditions.

Correct! There is always potential for injury when material falls from a clay vein.

Regardless of the number, bolts through a clay vein are not recommended for supporting the roof.

Bolt type can't be identified from this slide.

Correct! The use of headers would provide additional support. The roof bolts through the clay vein most likely provide very little support.

You may want to do this at a later time, but you should do something else first. Try again!

Setting temporary posts could become necessary, but you must do something else first. Try again!

This action is not necessary at this time. Try again!

Correct! The loose hanging roof rock must be pulled down first. Do the next question.

Correct! Advise the foreman of the situation and tell him what corrective actions you want to take.

Correct! It is doubtful that you will have all the necessary tools but you might have some of them. This will give you an idea of what additional tools are needed.

Although it would be good to have transportation outby the area to be scaled, nobody should be subjected to any additional danger by traveling under the identified roof condition.

Correct! The dispatcher should always know what is happening on haulage roads.

Experienced miners should be able to decide if loose top needs to be scaled down, at least for their own safety.

The proper tools for the job should always be used, not just what is on hand.

Correct! You should never abandon a piece of equipment on the main haulage. One person should stay behind.

Correct! The area above, below, behind, beside and ahead should be examined to assess the full extent of the condition.

Correct! Sounding the roof is always an appropriate action to determine how extensive the separation problem is. The bad roof condition could extend beyond the noticeable area.

Correct! A safe working plan can eliminate the potential for injury when scaling roof.

Correct! A safe footing area must be established.

Correct! You can eliminate the potential for electrocution by using the wire guards from your locomotives. However, as with any safety equipment, they are useless if they are not used, or not used properly.

This isn't necessary because it will not change the roof condition.

You don't know this yet.

Correct! These are important concerns for safe barring work.

This action is not necessary at this time, since you are working in the area.

Excessive body movements could cause you to lose control of the bar and be injured. You could also lose your balance and fall under the bad top.

Correct! Gloves can provide protection to hands and also improve your grip. Wearing safety glasses is a must when performing any work task.

You could lose control of the bar by picking or jabbing and injure yourself and/or others.

You should stop occasionally, step back, and look at the roof to be sure that conditions have not been made worse by your actions. Besides, it is a good idea to stop and rest periodically to avoid becoming exhausted.

Correct! Overhead barring is very strenuous. People who aren't used to that activity can easily become arm weary and endanger themselves and others.

Correct! Solid footing is very important for safety, not only for you, but also for others working nearby.

This is not a barring practice. Rockdust is not a concern at this time.

You should do something else before knocking the power. Try again!

This is dangerous. This action places the workers too close to the energized trolley wire. Try again!

Correct! The dispatcher must be informed of any temporary loss of power. He will then inform other employees inby the outage and get back with you. Do the next question.

This is not necessary. In addition, you and Lynnbo are not trained wiremen.

Correct! This is an important step. The locomotive will not be able to maintain air to the braking system after the power is off.

Do not rely on the lights going off on the locomotives to tell you that the wire is de-energized. Many locomotives have a battery system for their light control. Their lights would not go off in that situation. It is best to wait for Lynnbo to come and tell you the power is off.

Correct! Lynnbo should not only knock the power but he must lockout and danger tag the switch. Lynnbo must also block access to the trolley switch from other vehicles. Any vehicle that crosses the trolley wire switch could send power inby. Access can be denied by placing a board or some other non-conductive material from the trolley switch guard boards to the opposite side rail.

Not yet. There are things that need to be done before energizing the trolley wire.

Correct! You cannot assume that other people or equipment are not in contact with the wire somewhere else in the mine.

The person who turns off the power should be the one to turn it back on. This procedure can eliminate the danger of another worker being accidentally electrocuted.

Correct! Compliance with the roof control plan could now be a problem depending upon how much roof material has been taken down.

Correct! The "fire boss" found the area to be safe at the time of his inspection. However, conditions do change and hazards can develop anytime after the examination.

Correct! However, you should be able to take the initiative when it is a small job. Your extra effort could save someone from an injury.

Correct! Even though a hazardous condition may not affect you now, it could be dangerous to you or others later.

Correct! Inspectors and foremen are responsible for safety but they can't see every hazard. They need your help.

Correct! But good housekeeping and a little effort can sometimes prevent a small problem from developing into a major one.

Correct! Because his bar is too short, he is standing directly under bad roof.

Correct! Bad footing is potentially hazardous.

Correct! This should be done before you start.

Correct! They are standing directly under bad roof.

Correct! Bad footing is potentially hazardous.

Correct! Bars are designed to be used by just one person. If enough force cannot be applied by one person, additional leverage can be provided by extending the bar with a section of pipe.

They have taken the proper step of guarding the wire.

Correct! Safety glasses should be worn to protect him from a serious eye injury.

Correct! The short bar puts you in danger by forcing you to work too close to the bad area.

Correct! Trolley wire guard that is too short for the work area is unsafe to use.

Correct! He could drop his bar on you, or pull loose rock down on top of you.

Correct!

Correct!

Correct! A bent bar can throw the miner off balance and should not be used.

Correct! The miner is standing beneath good bolts.

Correct! The bar is long enough that his hands are not above his shoulders.

You can't determine this because his feet can't be seen in this slide.