

Roof Support in a Primary Escapeway

Instructor's Copy

Mining Systems and Human Engineering
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Pittsburgh, Pennsylvania

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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 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 them¹. 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 viewer 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.

Type:	Invisible ink with 3-D slide reel
Audience:	Underground coal miners
Length:	Ten questions (30 minutes for administration plus 30 for discussion)
Skills:	Recognition of coal mine roof hazards. Identification of dangerous roof conditions associated with high fall areas and with mine areas affected by moisture. Knowledge of methods for control of roof affected by moisture that has deteriorated rock around bolt heads.
Location:	Underground coal mine
Problem:	On a recent run of the escapeways by the section boss, he notices that the brow of a high fall area has begun to deteriorate. On this particular day; the face boss asks the miner operator and his helper to follow the escapeway out from the face and take down any loose top at the high fall area. After correcting this problem, the men encounter another hazardous roof condition nearby. This involves deterioration of the immediate roof from around bolts as a result of moisture in the mine air.

¹ You can do this yourself if you have the proper equipment, or you may obtain copies of 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.

² These may be purchased from your local toy store or purchased directly from View-Master, Special Markets, 636 Girard Avenue, East Aurora, NY 14052-1885, phone 716-687-3899.

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.
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, and each group of 3 to 5 persons an answer sheet and a developing pen.
 - 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 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 Roof Support in a Primary Escapeway

Objective number	Capability verb	Description of required performance and conditions under which it is to occur
1. HR ³	Recognize	Existing roof hazards and conditions that can lead to hazards
2. HR	Identify	Cues that indicate potential ground hazards
3. HR	Discriminate Assess	Roof conditions that may be hazardous and require some type of action

³ Skill and knowledge domain abbreviations:
HR = hazard recognition

Master Answer Sheet for Roof Support in a Primary Escapeway

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 (Choose only ONE unless you are told to "Try again!")

1. [You shouldn't judge roof support by the number of bolts in place. Try again!]
2. [In addition to the sound and vibration test there are other ways to check
[the mine roof. Try again!]
3. [Correct! A slab of the immediate roof is hanging over a bolt plate. Do
[the next question.]
4. [The condition of the immediate roof lying between the bolts must also be
[be examined. Try again!]
5. [The absence of rockdust is probably just an oversight; if slabbing
[occurred recently, bolts and bearing plates would not be flush with the
[surface. Try again!]
6. [Look at slide 1 again. Check the edges of the area shown. Try again!]

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

7. [This is unsafe. If you have to move quickly to get out of the way of falling
[rock, you could be seriously injured. Try again!]
8. [Correct! If you can't take care of a roof problem that appears hazardous
[then it should be reported to your boss. Do the next question.]
9. [This is not a wise choice because it's difficult to predict when loose rock
[like this may fall from the roof. Try again!]
10. [You don't have the proper materials with you to do this job. Try again!]

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

11. [Correct! He is standing in a hazardous spot. Do the next question.]
12. [You need to do something else first. Try again!]
13. [Very dangerous! You and D.R. could be injured. Try again!]
14. [Dangerous! You need to do something about this now. Try again!]

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

- 15. [Correct! It's impossible to predict when this will happen.]
- 16. [More bolts in the roof slab would not make this condition less hazardous.]
- 17. [Correct! Any separation, regardless of size, is a potentially dangerous
[condition.]
- 18. [This is not a factor. Once the immediate roof separates like this the
[effectiveness of any bolt type would be questionable.]
- 19. [Correct! If the slab breaks loose and falls on someone it could cause serious
[injury or death.]
- 20. [Correct! There is no way of knowing just how extensive this problem is.]

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

- 21. [You're taking too much of a chance. Try again!]
- 22. [Not a good practice. In a crisis situation the last thing a miner needs is
[confusion. Try again!]
- 23. [If anyone has to use the escapeway, serious problems could develop.
[Try again!]
- 24. [Correct! This is the proper action to take before correcting a problem that
[will close the primary escapeway. Do the next question.]

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

- 25. [Something else should be done first. Try again!]
- 26. [Temporary supports should not be placed at random. Try again!]
- 27. [Correct! The supports will protect you and D.R. while taking down the loose
[the loose top. Do the next question.]
- 28. [This is a dangerous practice that can cause serious injury. Something else
[needs to be done. Try again!]

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

- 29. [Correct! This is a serious problem that needs to be corrected.]
- 30. [This is not present here. There are no glossy or polished surfaces visible here.]
- 31. [Correct! These bolts are giving little or no support to the mine roof.]
- 32. [Correct! This is a condition sometimes referred to as "chandelier roof".]
- 33. [This can't be seen here. It can only be seen by close inspection after
[the bolt is exposed or after a fall.]
- 34. [Correct! This is one of the most critical problems here.]

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

- 35. [The number of bolts has little to do with quality of support. Try again!]
- 36. [The effective bearing area of the bolt plates has decreased
[significantly. Support is questionable. Try again!]
- 37. [It is impossible to predict how long this roof will stay up. Try again!]
- 38. [Correct! The effectiveness of these bolts is questionable.]

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

- 39. [This is possible, but it's also possible that the roof may collapse today or
[tomorrow. Try again!]
- 40. [The roof on the right side of the entry may look OK, but it really is no better
[supported than the left. Try again!]
- 41. [Even if the roof sounds solid, this is not a good test for this condition. The
[bolts are not properly supporting the roof. Try again!]
- 42. [Correct! Any of several types of additional support would be effective for this
[type of roof.]

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

43. [Correct! This will increase the bearing area of the plate.]
44. [Correct! This will enlarge the bearing area.]
45. [Correct! This was one of the first materials used for additional support
[between bolts.]
46. [Correct! This is perhaps the most common material used for complete
[lagging between bolts.]

Finding your score

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

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

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

Highest possible score = 46

Lowest possible score = 0

Instructor's Discussion Notes for Roof Support in a Primary Escapeway

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 answer is 3. High fall areas tend to be looked at in a somewhat casual manner by many workers. Unless hazardous ground conditions are very pronounced in these locations, subtle or inconspicuous dangers are often overlooked. Miners may feel that because the area has already fallen and been resupported, it is safe and will not cause problems again. Answers 1, 2, 4 and 6 reflect this casual attitude that many miners have when passing through a high fall area. Workers need to take time and be more cautious about these areas and assume nothing. The absence of rockdust (5) is probably just an oversight on the part of the operator or maybe the crew didn't get back to complete the job yet.

Question B - The correct answer is 8. The top clearly needs to be scaled down. However, using the jeep as a "ladder" to reach the top (7) is unsafe. Even if the condition doesn't look particularly bad (9), the problem of loose roof rock should be addressed as soon as possible. Adding additional support (10) to this roof condition would be like applying a "band aid" to the problem, and would be difficult to add because of the cavity height. This loose roof needs to be scaled down.

Question C - The correct answer is 11. There is immediate cause for concern here, particularly for a person standing under this high fall. Standing anywhere near the brow of this fall area (12)(13) is dangerous because the extent of the problem is unknown. The problem should definitely not be overlooked (14).

Question D - The correct answers are 15, 17, 19 and 20. The separation between the slab and the main roof is clearly visible. It is large and potentially dangerous, and could break off at any time. It should be viewed as a symptom or warning that other separations may be possible in this high fall area. Workers should be aware of this visual clue. From the information given and the slide, one can't determine whether there are too few bolts holding the slab in place (16) or that the wrong types of bolts may have been used (18), although these may, in fact, be the cause of the hazards shown.

Question E - The correct answer is 24. It is vital to everyone concerned that escape routes are identified, marked and known. In a crisis situation, particularly where smoke is involved, it is critical that all workers know exactly which escapeway can be used (21). Dangering off a primary escapeway is only done as a last resort with the full knowledge of the section foreman. It would be wrong for the workers to danger off the area and not tell anyone (22)(23).

Question F - The correct answer is 27. It is important to remember that when scaling is being done, temporary supports should be placed under the good roof area. These supports should not be placed at random (26). They are supposed to protect workers from danger. Work should always proceed from the good area toward the bad. Miners shouldn't expose themselves to hazards by working under the bad roof area (25)(28).

Question G - The correct answers are 29, 31, 32, and 34. All of the hazards noted in these correct answers are obvious ones. Slickensides (30) may exist within the roof, and may be the cause of the condition shown, however, they are not visible in the slide. Rusted bolts (33) may also exist within the roof, however, they are not apparent to the observer. Bolts that "pencil off" or shear due to rusting (mostly mechanical bolts) are a problem of a different nature. This condition may develop after several years time and not be recognized by workers until failure of one or more bolts occurs.

Question H - The correct answer is 38. For roof bolts of any type to be effective, the bearing plates should be in contact with the immediate roof. The breakup and subsequent spalling of rock around bolt heads weakens the integrity of the beam formed when the bolts are initially installed. The support of the mine roof shown in SLIDE 5 is very suspect. The number and position of bolts in place (35)(36) means very little if they are not doing the job for which they are designed. Workers shouldn't be fooled into believing that older areas of mines (37) are safer just because they have been open longer.

Question I - The correct answer is 42. The only feasible solution for this type of potentially hazardous condition is to place new bolts in the roof or install posts or cribs. At some mines the old bolts are sheared off or removed after new ones are installed. However, this is not the normal practice. Clearly something needs to be done even if the roof sounds OK (41). Adding bolts or other types of support to the left side of the entry will only correct half the problem (40).

Question J - All four of the answers are correct. Resupport of chandelier roof is sometimes accomplished using bolts that are similar to those originally installed. However, some operators plan ahead and install other types of additional support to prevent recurrence of the problem. All are effective and the particular one chosen is usually determined by cost and material availability.

References

- Cummins, Arthur B. and Given, Ivan A., SME Mining Engineering Handbook, Vol.1 1973, Section 13.
- Jeran, Paul W. and Jansky, Jacqueline, A Guide to Geologic Features in Coal Mines in the Northern Appalachian Coal Basin, Bureau of Mines, IC 8918, 1983.
- Milici, Robert C. and Gathright, Thomas M., Geologic features Related to Coal Mine Roof Falls - A Guide for Miner Training, Department of Mines, Minerals, and Energy, Division of Mineral Resources, 1985.
- Moebs, Noel N. and Stateham, Raymond M., "The diagnosis and reduction of mine roof failure", *Coal Mining*, March, 1985.

Scoring Key for Roof Support in a Primary Escapeway

The correct answers are marked with an asterisk.⁴

Question	Answer Number					
A	1	2	3*	4	5	6
B	7	8*	9	10		
C	11*	12	13	14		
D	15*	16	17*	18	19*	20*
E	21	22	23	24*		
F	25	26	27*	28		
G	29*	30	31*	32*	33	34*
H	35	36	37	38*		
I	39	40	41	42*		
J	43*	44*	45*	46*		

⁴ This 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 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.

Roof Support in a Primary Escapeway

Problem Booklet

Instructions

Read the problem situation described on the next page. Then answer each of the 10 questions. Do them one at a time. Some questions will ask you to look at one or more 3-D slides. Follow the directions for each question. Look at the appropriate slide or slides, then continue on with the exercise. Don't jump ahead, but you may look back to earlier questions and your answers. Most questions direct you to choose only one answer unless you are told to "Try again!" Some questions tell you to select as many answers as you think are correct. Follow the directions for each question.

After you have selected your choice to a question, look up the number for that choice on the answer sheet. Rub the developing pen between the brackets for that choice. A hidden message will appear that tells you if the choice is correct and provides you with additional information. When you finish you will learn how to score your performance.

Background

You are a roof bolter with five years job experience.

Your helper, D. R. Light, has one year underground experience.

This coal mine has recently been reopened after being idle for several years. The coal seam is slightly more than six feet thick.

The immediate roof of the mine is approximately 3 1/4 feet of shale. Above this is 4 1/2 feet of limestone.

The following types of bolts are used for roof support: mechanical, resin, or combination (mechanical/resin).

Problem

The section boss is required to walk the escapeways leading out to East Mains each week looking for hazardous conditions. If any are found, he must see that corrections are made. On his last run two days ago, he noticed that the roof and brow in the high fall area at the mouth of 2 North has started to deteriorate. He felt the situation could become hazardous, however, he didn't feel it was urgent at that time. Today the continuous miner is down, so he asks you and D.R. to follow the escapeway out to the high fall area. You are to make corrections and, if necessary, take down any loose top. Turn the page and answer the first question.

Question A

After receiving instructions from the face boss, you and D.R. load a supply jeep with scaling bars, posts, cap blocks and wedges. You head outby to the mouth of 2 North. You arrive and park the vehicle near the edge of the high fall area. You start to inspect the roof beginning at the center of the dome, which you estimate to be thirty feet high. LOOK AT SLIDE 1.

How does the roof look to you? (Choose only ONE unless you are told to "Try again!")

1. The roof is OK because there are more than enough bolts in place throughout the cavity.
2. Assume that the roof is safe, since it is too high to conduct a sound and vibration test.
3. Even though the roof at the center of the dome is very high, you suspect a hazardous condition near the center.
4. The roof is safe. All bolts and plates appear to be in good contact with the immediate roof.
5. The roof is not safe because the absence of rockdust on the surface indicates that sloughing has recently occurred.
6. The roof looks good. Don't be concerned about it.

Question B

You and D.R. have identified this area as potentially hazardous. LOOK AT SLIDE 2. This is a close-up view of the hazardous condition. What should you do? (Choose only ONE unless you are told to "Try again!")

7. By standing on the jeep, scale the top with a bar to remove the loose slab .
8. Report the situation to your section boss. You can't reach the top with the equipment you have with you.
9. Do nothing. You've seen roof like this before and it never caused a problem. You should not be concerned.
10. Add additional support to prevent the top from sloughing.

Question C

You and D.R. decide to take a closer look around the high fall area before you report to your section boss. The lower edge of the cavity, directly above where D.R. is standing, catches your attention. This is what you see. LOOK AT SLIDE 3.

What should you do now? (Choose only ONE unless you are told to "Try again!")

11. Immediately yell to D.R. to move away from the edge of the high fall area into the main entry.
12. Ask D.R. to take a close look at the edge of the cavity and see what he thinks about it.
13. Move to where D.R. is standing and help him inspect the top.
14. Continue with your inspection of the roof and return to this area later.

Question D

You recognized the roof hazard and yelled to D.R. to move away from the brow. He is now standing where he is safe. However, before you and D.R. can begin to make corrections you should recognize the extent of the problem. What are the hazards here? (Select as MANY as you think are correct.)

- 15. The slab could break off and fall at any time.
- 16. There are too few bolts holding the slab up.
- 17. There is a small gap between the slab and the main roof.
- 18. The wrong types of roof bolts were used.
- 19. The slab is large and is probably very heavy.
- 20. Other parts of the roof near the loose slab may also be separated from the main roof.

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

Question E

You and D.R. decide the area near the brow should be immediately dangered off and the problem corrected. However, this entry is the primary escapeway out of your section. What should you do now? (Choose only ONE unless you are told to "Try again!")

21. Begin to correct the problem. The escapeway probably won't need to be used until you are finished.
22. Begin working. If anyone comes out the escapeway, detour them around the high fall area until you're finished.
23. Danger the area off and begin to correct the problem.
24. Send D.R. to the face to tell the boss that you have to danger off and correct a roof problem. Since this is the primary escapeway, the boss should tell the miners to use the secondary escapeway.

Question F

D.R. returns from the face after telling the section boss that the primary escapeway will be dangerous until the roof problem is corrected. While at the face, D.R. also reported the roof condition at the center of the cavity. He returns with a longer bar and pipe to scale down the loose slab. Now it's time to start working. You danger off the entry. What should you do next? (Choose only ONE unless you are told to "Try again!")

25. Start to scale the loose top in the dome using the longer bar and pipe.
26. Set temporary supports at random around the high fall area and then scale down the loose top.
27. Set temporary supports under the good roof adjacent to the brow and begin to scale down the top.
28. Begin to pound the bad roof area near the brow using a wood post.

Question G

You and D.R. have safely and successfully pulled down the roof slabs. You leave the temporary posts in place until the fresh roof can be bolted. This should be done immediately, so you proceed to the face to get a jackleg drill and some bolts. The face boss sees you and gives you another job. When you finish rebolting, he wants you to take a look at the roof in East Mains just outby 2 North.

Roof conditions within the cavity, as well as the outside edge (or brow) of high fall areas can be a continuing source of problems. After high falls have been resupported, workers tend to pay little attention to the roof because it's assumed to be safe. These areas need to be examined on a regular basis. LOOK AT SLIDE 4.

What roof hazards do you see? (Select as MANY as you think are correct.)

- 29. Loose, broken roof rock.
- 30. Slickensided roof.
- 31. Loose hanging roof bolts.
- 32. Sloughing of rock between bolts.
- 33. Rusted bolts.
- 34. Hanging slabs of rock at the brow of the high fall area.

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

Question H

You complete bolting at the high fall area and remove the temporary posts. You and D.R. walk to East Mains and look at the roof. LOOK AT SLIDE 5.

What can you tell about this roof? (Choose only ONE unless you are told to "Try again!")

- 35. There are more than enough bolts in the roof, so support is OK.
- 36. Most of the bolts and bearing plates are in contact with the roof, so the roof is adequately supported.
- 37. This is an older area of the mine. Since the roof is still intact, it will probably remain that way for a long time.
- 38. There is significant rock sloughing between bolts, so the bolts are probably not supporting the roof.

Question I

You saw in SLIDE 5 what is sometimes called "chandelier roof". The support of this mine roof appears uncertain. It is difficult to predict how long the roof will remain in place. Spalling of rock between bolts may cause the roof support to be ineffective. What can be done with this roof? (Choose only ONE unless you are told to "Try again!")

- 39. Nothing. It will probably stay up as long as the entry remains open.
- 40. Additional roof support should be added to the left side of the entry.
- 41. Leave it alone if it appears solid after the roof is sounded.
- 42. Additional roof support should be added across the width of the entry.

Question J

Chandelier roof is a condition that generally develops in a mine roof of shale or claystone. The rock around roof bolts deteriorates and sloughing occurs. This deterioration of rock, commonly called "slaking", is usually caused by moisture in the mine air. Some mines install "tempering chambers" to remove moisture from incoming air. Others, particularly if the mine has a serious problem, spray sealants to protect the roof from moisture. In some mines, however, chandelier roof is a problem that can be corrected by spot bolting. LOOK AT SLIDES 6 and 7.

These are examples of more advanced rock spalling between bolts. In addition to rebolting with similar bolts, what are some other effective types of additional support that can be used for chandelier roof? (Select as MANY as you think are correct.)

- 43. Wood headers under steel bearing plates.
- 44. Steel I beams or wood beams.
- 45. Lengths of structured steel channel.
- 46. Woven steel/wire mesh.

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 27. Write the difference in the second blank on the answer sheet.
3. Add the numbers on the first and second blanks. This is your score.

The best possible score of 46 results from selecting all the correct answers and no wrong answers. The worst possible score of zero results from selecting all the wrong answers and no correct answers.

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.

Answer Sheet for Roof Support in a Primary Escapeway

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 (Choose only ONE unless you are told to "Try again!")

- 1. []
- 2. []
[]
- 3. []
[]
- 4. []
[]
- 5. []
[]
[]
- 6. []

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

- 7. []
[]
- 8. []
[]
- 9. []
[]
- 10. []

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

- 11. []
- 12. []
- 13. []
- 14. []

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

- 15. []
- 16. []
- 17. []
[]
- 18. []
[]
- 19. []
[]
- 20. []

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

- 21. []
- 22. []
[]
- 23. []
[]
- 24. []
[]

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

- 25. []
- 26. []
- 27. []
[]
- 28. []
[]

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

- 29. []
- 30. []
- 31. []
- 32. []
- 33. []
[]
- 34. []

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

- 35. []
- 36. []
[]
- 37. []
- 38. []

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

- 39. []
[]
- 40. []
[]
- 41. []
[]
- 42. []
[]

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

- 43. []
- 44. []
- 45. []
[]
- 46. []
[]

Finding your score

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

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

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

Highest possible score = 46

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 shouldn't judge roof support by the number of bolts in place. Try again!

In addition to the sound and vibration test there are other ways to check the mine roof. Try again!

Correct! A slab of the immediate roof is hanging over a bolt plate. Do the next question.

The condition of the immediate roof lying between the bolts must also be examined. Try again!

The absence of rockdust is probably just an oversight; if slabbing occurred recently, bolts and bearing plates would not be flush with the surface. Try again!

Look at slide 1 again. Check the edges of the area shown. Try again!

This is unsafe. If you have to move quickly to get out of the way of falling rock, you could be seriously injured. Try again!

Correct! If you can't take care of a roof problem that appears hazardous then it should be reported to your boss. Do the next question.

This is not a wise choice because it's difficult to predict when loose rock like this may fall from the roof. Try again!

You don't have the proper materials with you to do this job. Try again!

Correct! He is standing in a hazardous spot. Do the next question.

You need to do something else first. Try again!

Very dangerous! You and D.R. could be injured. Try again!

Dangerous! You need to do something about this now. Try again!

Correct! It's impossible to predict when this will happen.

More bolts in the roof slab would not make this condition less hazardous.

Correct! Any separation, regardless of size, is a potentially dangerous condition.

This is not a factor. Once the immediate roof separates like this the effectiveness of any bolt type would be questionable.

Correct! If the slab breaks loose and falls on someone it could cause serious injury or death.

Correct! There is no way of knowing just how extensive this problem is.

You're taking too much of a chance. Try again!

Not a good practice. In a crisis situation the last thing a miner needs is confusion. Try again!

If anyone has to use the escapeway, serious problems could develop. Try again!

Correct! This is the proper action to take before correcting a problem that will close the primary escapeway. Do the next question.

Something else should be done first. Try again!

Temporary supports should not be placed at random. Try again!

Correct! The supports will protect you and D.R. while taking down the loose the loose top. Do the next question.

This is a dangerous practice that can cause serious injury. Something else needs to be done. Try again!

Correct! This is a serious problem that needs to be corrected.

This is not present here. There are no glossy or polished surfaces visible here.

Correct! These bolts are giving little or no support to the mine roof.

Correct! This is a condition sometimes referred to as "chandelier roof".

This can't be seen here. It can only be seen by close inspection after the bolt is exposed or after a fall.

Correct! This is one of the most critical problems here.

The number of bolts has little to do with quality of support. Try again!

The effective bearing area of the bolt plates has decreased significantly. Support is questionable. Try again!

It is impossible to predict how long this roof will stay up. Try again!

Correct! The effectiveness of these bolts is questionable.

This is possible, but it's also possible that the roof may collapse today or tomorrow. Try again!

The roof on the right side of the entry may look OK, but it really is no better supported than the left. Try again!

Even if the roof sounds solid, this is not a good test for this condition. The bolts are not properly supporting the roof. Try again!

Correct! Any of several types of additional support would be effective for this type of roof.

Correct! This will increase the bearing area of the plate.

Correct! This will enlarge the bearing area.

Correct! This was one of the first materials used for additional support between bolts.

Correct! This is perhaps the most common material used for complete lagging between bolts.