



mineral resources

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Learners/Examiners Guide

for the

Assessment and Certification

of

Blasting Certificate

HOLDERS for Opencast Mines

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SECTION 1

INTRODUCTION

PURPOSE

The purpose of this guide is to assist examiners/assessors and training service providers towards implementing a structured, fair and consistent method of assessment. It also attempts to bring about uniformity across the various Regions of the Department of Mineral Resources.

SYLLABI

The syllabi is clearly defined so that the learners, training service providers and examiners/assessors are fully aligned with the study, assessment/examination material for the Blasting Certificate of Competency for Opencast Mines. The syllabi is contained in section 2 of this guide.

ASSESSMENT GUIDELINES

This section has been included to guide the learners and examiners/assessors on the assessment principles, which have been implemented. The assessment guidelines are contained in section 3 of this guide.

ASSESSMENT SCORE SHEET

This section has been included for assessment purposes. There are two types of assessment score sheets namely score sheet for compulsory questions and score sheet for Choice questions. The two types of assessment score sheets are contained in section 4 of this guide.

QUESTIONS AND MODEL ANSWERS

Questions and Model Answers that are relevant to the Blasting Certificate for Opencast mines are contained in section 5 of this guide.

GENERAL RULES FOR EXAMINATION/ASSESSMENT

Examinations/Assessments are to be conducted in accordance with this guide.

IMPORTANT INFORMATION

This Examiners/Learners Guide for the assessment and certification of Holders of Blasting Certificate for Opencast mines has been made available to all the Examiners/Assessors, Employers Representatives, Employees' Representatives, Training Service Providers, Mining Qualifications Authority (MQA) and other interested parties.

Copies of this Examiners/Learners Guide for the assessment and certification of Blasting Certificate Holders for Opencast mines can be obtained from the Department of Mineral Resources.

SECTION 2

SYLLABI

BLASTING CERTIFICATE FOR OPENCAST MINE

This syllabi includes the relevant provisions of the Mine Health and Safety Act, 1996 (Act 29 of 1996) as amended and the regulations under the Minerals Act, 1991 (Act 50 of 1991) still in force in terms of schedule 4 of the Mine Health and Safety Act, 1996 (Act 29 of 1996) as amended.

1 SURFACE MINE LEGAL KNOWLEDGE AND APPLICATION

- 1.1 Mine Health and Safety Act and Regulations
- 1.2 Minerals Act and Regulations
- 1.3 Explosives Act and Regulations
 - 1.3.1 Definitions
 - 1.3.2 Responsibilities of the Employer/Manager
 - 1.3.3 Duties of a Miner
 - 1.3.4 Accident Reporting/Investigation
 - 1.3.5 Hazard Identification/Risk Assessment

2 SURFACE MINE PRACTICES AND PROCEDURES

- 2.1 Rock Engineering and Slope Stability
- 2.2 Protection of Workings
- 2.3 Surface Mine Procedures
- 2.4 Drilling

3 SURFACE MINE MACHINERY

- 3.1 General
- 3.2 Mobile Mechanical Equipment
- 3.3 Conveying Equipment

4 INTRODUCTION TO EXPLOSIVES

- 4.1 Types and properties of explosives
- 4.2 Types of initiation systems
- 4.3 Manufacture of explosives

5 TRANSPORT, STORAGE AND SECURITY OF EXPLOSIVES

- 5.1 Transport
- 5.2 Explosive Storage
- 5.3 Security

6 BASIC BLASTING DESIGNS

- 6.1 Design factors
- 6.2 Patterns
- 6.3 Priming and initiation
- 6.4 Environmental effects

7 BLASTING PROCEDURES

- 7.1 Preparation of Explosives
- 7.2 On site use/storage
- 7.3 Charging procedures
- 7.4 Blasting procedures
- 7.5 Treatment of misfires
- 7.6 Destruction of old explosives

8 PRACTICAL BLAST LAYOUTS

- 8.1 Open Pit Mining
- 8.2 Quarry Mining

9 DUST PREVENTION

- 9.1 Causes of dust
- 9.2 Dust control
- 9.3 Dust prevention

SECTION 3

ASSESSMENT GUIDELINES

WHAT IS ASSESSMENT?

Assessment is a process of gathering evidence and making judgement about a person's knowledge and skills. There are various purposes and forms of assessment. In the case of the Blasting Certificate, the candidate's knowledge and skills is assessed, using the syllabi, questions and model answers contained in this guide.

During the assessment, evidence is collected that is used as the basis on which to make judgement about the person's knowledge and skills. Assessment should be as close as possible to the way that knowledge and skills are applied.

ASSESSMENT PRINCIPLES

It is envisaged that Blasting Certificate assessment process will be based on the principles listed below:

Principles	Definitions
	Assessment must:
Access to assessment	Be conveniently available to all employees
Developmental	Yield results that candidates, programme planners and others can use as part of development processes to improve the performance of learners and the services of programmes, such as career counselling.
Fairness	Use methods, instruments and processes which are sensitive to various forms of bias and discrimination, such as cultural values, language, etc.
Integrative	Assess the skills, knowledge and value outcomes of learning in an integrative manner and not in isolation from each other
Multi-lingualism	Be conducted in accordance with the Directive for Blasting Certificate for Opencast mines so that language shall not be a barrier to demonstrating one's competence. Candidates have the right to assessment in the language of their choice, whenever possible.
Outcomes-based assessment	Be based on learning outcomes stated in the Directive for Blasting Certificate for Opencast mines
Relevance	Focus on skills, knowledge and values that are relevant to the learning outcomes; and be appropriate and close to the ways in which people learned and how they will use or apply the skills and knowledge which are being assessed.
Reliability	Be reliable, i.e. the assessment must produce similar results consistently, regardless of assessor or context
Transparency and democracy	Be clear and understandable to the candidates.

SECTION 4

The examination/assessment consists of two types of questions namely compulsory questions and choice questions

4.1 COMPULSORY QUESTIONS

- a) The score sheet to compulsory questions, DMR 308, must be used in preparing for, and assessing a candidate.
- b) The examiner must assess/examine the candidate on a minimum of five compulsory questions in each subject (All candidates must be examined/assessed on equal number of questions).
- c) The pass mark on compulsory questions is 100%.
- d) Questions asked under the compulsory section relate to core knowledge that a miner is required to have.
- e) The intention of the compulsory question is to ascertain whether the candidate has the knowledge of issues that may impact on the health and safety of employees under his/her control.
- f) The candidate must answer all questions asked that may impact on the health and safety of employees by demonstrating an understanding of the associated risks to the satisfaction of the examiner in the abovementioned part of the examination/assessment.
- g) The examiner must record all questions asked and complete the 'Assessor Remarks' section on the score sheet if the candidate gives an unsatisfactory answer.

4.2 CHOICE QUESTIONS

- a) The score sheet for choice questions, DMR 309, must be used in preparing for and assessing a candidate.
- b) The examiner must assess/examine the candidate on a minimum of five choice questions in each subject (All candidates must be examined/assessed on equal number of questions).
- c) The pass mark on choice questions is 60%.
- d) The examiner is not restricted to only the above-mentioned questions, provided that the question he/she may ask are still within the boundaries of the syllabus and remain relevant to the Blasting Certificate of Competency for Opencast mines.
- e) The examiner must record all the questions asked and completes the "Assessor Remarks" section on the choice questions score sheet if the candidate gives an unsatisfactory answer.

SECTION 5

QUESTIONS AND MODEL ANSWERS

COMPULSORY QUESTIONS

5.1 SURFACE MINE LEGAL KNOWLEDGE AND APPLICATION

Question 1

List the objectives of the Mine Health and Safety Act.

Answer **[MHTSA Section 1]**

- a) To protect and promote the health and safety of persons working at a mine
- b) To promote a culture of safety
- c) To promote the effective monitoring of health and safety conditions at mines
- d) To require employers and employees to identify hazards and to eliminate, control and minimize risk
- e) To provide for employee participation
- f) To promote training

Question 2

What are the rights and powers of a health and safety representative?

Answer **[MHTSA Section 30]**

- a) The manager must assist him to perform his functions as a health and safety representative.
- b) He must be allowed to meet with the workers he represents.
- c) He may instruct a fellow worker to leave a place of work if there is a serious danger.
- d) He may request an inspector to investigate any matter regarding health and safety that he is concerned about.
- e) He must be informed whenever there is an accident and when and where there is an inspection. (He may partake in any health and safety inspection).
- f) He must be allowed time off, with pay, to attend training courses.

Question 3

Name the person that the Minister of Mineral Resources must appoint to assist him/her.

Answer **[MHTSA Section 48(1)]**

The Mine Health and Safety Act requires the Minister to appoint a Chief Inspector of Mines.

Question 4

State three functions of the Chief Inspector of Mines.

Answer **[MHTSA Section 49(1)]**

- a) Administer the Act and the Mine Health and Safety Inspectorate
- b) Appoint inspectors to assist him/her
- c) Advise the Minister on health and safety in mines

Question 5

State what the Act requires owners, employers and employees to do with regard to Inspectors of Mines.

Answer **[MHTSA Section 52(1)]**

The Act requires the owner, employers and employees to provide an Inspector of Mines with assistance and facilities that he/she may reasonably require during an inspection.

Question 6

State what the Act requires about answering questions asked by an Inspector.

Answer **[MHSA Section 52(2)]**

Any person questioned by an Inspector of Mine must answer each question to the best of their ability, but no person is required to answer any question if the answer may be self-incriminating.

Question 7

Name six offences listed under the Act.

Answer **[MHSA Sections 84, 86, 87, 88, 89, 90 and 91]**

- a) It is an offence to damage, misuse or interfere in any way with health and safety equipment that is provided for use in the mine.
- b) It is an offence if a negligent act or omission by one person endangers the safety and health of another person at a mine.
- c) It is an offence if a person hinders any other person who is performing a function in terms of the Act.
- d) It is an offence if a person attempts to obtain any certificate of competency in a dishonest or fraudulent manner.
- e) A person who fails to attend an inquiry which he was instructed or summoned to do, and who fails to answer questions or gives false evidence, commits an offence.
- f) Any person who contravenes or fails to comply with the provisions of the Act or any instructions issued under the Act, commits an offence.

Question 8

State what can happen to a person if found guilty of an offence under the Act.

Answer **[MHSA Section 91(1)]**

Any person convicted of an offence in terms of the Act may be fined by the court, or imprisoned as may be prescribed.

Question 9

Define the following terms:

- a) Inspector
- b) Employee
- c) Employer
- d) Hazard
- e) Risk
- f) Health and safety representative
- g) Health hazard
- h) Occupational health

NOTE: ***Definitions need not be quoted verbatim but the meaning thereof must be clearly expressed in the answer***

Answer **[MHSA Section 102]**

- a) *Inspector* means an officer appointed in terms of section 48(1)(c) of MHSA and a medical inspector appointed in terms of section 49(1)(b) of the MHSA
- b) *Employee* means any person who is employed or working on a mine
- c) *Employer* means any person who employs employees
- d) *Hazard* means a source of, or exposure to danger
- e) *Risk* means the likelihood that occupational injury or harm to persons will occur
- f) *Health and safety representative* means an employee elected and appointed in terms of section 29 of MHSA

- g) *Health hazard* means any physical, chemical or biological hazard to health, including anything declared to be a health hazard by the Minister
- h) *Occupational health* includes occupational hygiene and occupational medicine

Question 10

State the employer's duties with regard to codes of practice at a mine.

Answer **[MHSa Section 9(1), (2) and (5)]**

The employer:

- a) May prepare and implement a code of practice on any matter regarding the health and safety of employees and other persons;
- b) Must implement a code of practice if the chief inspector requires it, in which case it must comply with the guidelines issued by the chief inspector;
- c) Must consult with the health and safety committee on the mine on the preparation and implementation of any code of practice.

Question 11

Name six duties that an employee at a mine has with regard to health and safety.

Answer **[MHSa Section 22]**

Every employee at the mine must:

- a) Take reasonable care to protect his own health and safety;
- b) Take reasonable care to protect the health and safety of other persons who may be affected by the work that he does;
- c) Take proper care of personal protective equipment and other safety facilities provided for his own and other person's safety and health;
- d) Report to his supervisor, anything which he believes is a risk to health and safety and which he cannot properly deal with himself;
- e) Co-operate with any person with duties and responsibilities under the act (e.g. An inspector, a supervisor, etc.);
- f) Comply with prescribed health and safety measures.

Question 12

State what rights an employee has with regard to leaving a dangerous working place and what the manager must do to enable employees to exercise this right.

Answer **[MHSa Section 23]**

An employee has the right to leave any working place whenever:

- a) Circumstances arise at the working place which, **with reasonable justification**, appear to that employee to pose a serious danger to his health and safety;
- b) The health and safety representative responsible for that working place tells him to leave that working place.
- c) The employer, after consultation with the health and safety committee or representative, must determine effective procedures to enable employees to exercise this right. These procedures must provide for:
 - i. Notification of supervisors and health and safety representative
 - ii. Participation of management and employee representatives to resolve the issue
 - iii. Participation, if necessary, of inspectors or technical advisers to resolve the issue.

Question 13

What is the definition of a manager?

Answer **[MHSa Section 102]**

Manager means any competent person appointed in terms of section 3 (1)(a)

Question 14

What is the definition of a Competent Person?

Answer**[MA Definitions]**

A person who:

A

- i. Is qualified by virtue of his knowledge, training, skills and experience to organise the work and its performance;
- ii. Is familiar with the provisions of the act and the regulations which apply to the work to be performed, and;
- iii. Has been trained to recognise any potential or actual danger to health or safety in the programme of the work; or

B

- i. Is in possession of the appropriate certificate of competency where such certificate is required by the regulations.

Question 15

Which legal appointments are required to be made by the employer at an opencast Mine?

Answer**[MHSA Sections 3(1)(a), 12.1, 13.3(a)(i) and MHSA Regulations 14.1(8) and 17.2(a)]**

- a) Manager
- b) Occupational Hygienist
- c) Occupational Medical Practitioner
- d) Rock Engineer
- e) Mine Surveyor

Question 16

Which legal appointments are required to be made by the manager at an opencast mine?

Answer**[MA Regulations 2.13.1, 2.13.2, 2.17.1, 2.17.4 and MHSA Regulation 6.9(a)]**

- a) Engineer – where power exceeds 2500 kW
- b) Competent Person for Machinery – where power is less than 2500 kW
- c) Safety Officer – where persons employed exceed 300
- d) Chief Safety Officer
- e) Health and Safety Representatives

Question 17

What work may be performed on a Sunday by a mine in terms of Section 9 of the Mines & Works Act of 1956?

Answer**[MWA Section 9(1) and 9(2)]**

- a) No person shall perform, or cause or permit any other person to perform at any mine or works, any work in connection with the operation of a mine or works, on a Sunday, Christmas Day, Day of Reconciliation or Good Friday, or cause any other person to perform, at any mine or works, any such work on Republic Day, unless the work is:
 - i. Attending to or working pumping or ventilating machinery, or machinery for the supply of light, heat or power, or any boiler belonging to any such machinery;
 - ii. Such work above or below the surface as cannot be delayed without causing danger or damage to life, health or property, including work in workshops necessary or incidental to any such work;
 - iii. Operating any continuous chemical, metallurgical or smelting process, if a stoppage thereof during the whole of any such day would either prevent its immediate resumption on the next succeeding day or diminish the effectiveness of the process;
 - iv. The running of stamp mills or other machinery used for crushing ore, erected before the first day of December 1911;

- v. The policing of the mine or works, or the carrying on of medical and health services or services in connection with housing and feeding; or
 - vi. Work in respect of which the Minister, in any particular case, on application in writing or, in general by notice in the Gazette, declared that in his opinion the performance thereof is necessary in the national interest.
- b) The Chief Inspector of Mines may, on application to an Inspector of Mines, grant special permission for carrying on temporarily any necessary work, in addition to work described in sub-section (1), at a mine or works on the days mentioned in that sub-section.

Question 18

What accidents must be reported to the Principal Inspector?

Answer

[MHS Regulation 23.1]

- a) The death of any person.
- b) Any injury to any person likely to be fatal.
- c) Unconsciousness or incapacitation from heatstroke, heat exhaustion, electric shock or the inhalation of fumes or poisonous gas.
- d) An injury which prevents the injured person from performing his normal or similar duties for 14 days or more.
- e) The loss of any limb, or part of limb.
- f) Any permanent disability sustained.
- g) Extensive caving or subsidence in the ground causing damage to the surface or endangering persons.
- h) Any accident due to explosives.
- i) Flooding of the workings.
- j) Failure of any dam or reservoir used for conserving water or slimes.
- k) Any fire.
- l) Any explosion of gas or dust.

Question 19

State the legal requirements regarding the provision and facilities of a change house.

Answer

[MHS Regulation 9.2(5)]

The employer must provide and maintain suitable and adequate:

- a) Change houses to enable employees who perform work involving hazardous substances to change into working clothes at the start of their shift and to wash themselves and change their clothes at the end of their shift.
- b) Facilities to enable employees who perform work involving hazardous substances to wash their hands and faces before eating any meals at work.
- c) Readily available latrine facilities, within a reasonable distance from each working place.

Question 20

What are the miner's responsibilities regarding the safety of all persons in his/her section?

Answer

[MA Regulations 8.1.4 and Code of Practice]

- a) The miner must take all reasonable measures to prevent persons not required to assist him/her from entering any such working place until he/she has examined and made safe and until he/she has given them definite instructions to enter
- b) In making any working place safe at the start of the shift the miner must take all reasonable precautions to ensure that any person assisting him/her is safe guarded against falls of ground and other dangers while carrying out such work
- c) If at any time a working place or part thereof becomes or is found to be unsafe during the shift, the miner in charge must take all reasonable measures for making it safe and the working place or part thereof which has been found to be unsafe must be barricaded off by the miner in charge, or guards must be placed and instructed by the miner in charge that inadvertent access to the place is impossible until it has

been made safe, and no person must enter such a place unless he/she has received definite instruction or permission from the miner in charge.

- d) In any working place the miner in charge must take all reasonable precautions against injury to any person from the falling or rolling of timber, rock, tools or other articles.
- e) The miner in charge must not allow any person to work or remain where he/she may be endangered by ground which to his/her knowledge any person has attempted to take down or remove until such time such ground has been made safe.
- f) If any or other person working under the supervision of the miner complains that the part of the working where he/she is required to work is dangerous, the miner must withdraw all workmen therefrom until he/she has personally, with such assistance as he/she may require, make it safe, or until such time he/she has had it examined by another person who must be the holder of a blasting certificate and has obtained the concurrence of such person as to the safety of such part. Until he/she has complied with this requirement, the miner must take all reasonable precautions to prevent the entry of any person to the part complained of, except such persons as is necessary to carry out or assist in carrying out the examination or the making safe.
- g) Before cutting hitches, setting props, building pigsties or packs or erecting other support under dangerous ground, or allowing dangerous ground or rock to be drilled into with the object of rock-bolting it or blasting it down, the miner in charge by setting of props or otherwise adequately safeguard any person engaged in such operations.
- h) No pigsty, pack, prop or other support must be withdrawn except on instruction of the miner in charge and then only after he/she has made a careful examination of the hanging wall or roof/sides and has set or supervised the setting of additional support or has taken such other precautions as may be necessary to ensure safety.

Question 21

When must a relieving Miner be appointed?

Answer **[Code of Practice]**

In cases of emergency, another Miner must be appointed in a manner prescribed by the manager.

Question 22

What will the first duty of a relieving Miner/Ganger be?

Answer **[Code of Practice]**

He/she must re-examine and where necessary make safe the working place which he/she has taken over from another miner

Question 23

When can a blasting certificate be withdrawn or cancelled?

Answer **[MA Regulation 29.3]**

If the holder of a blasting certificate is in the opinion of the Principal Inspector of Mines, found guilty of misconduct or gross negligence in the execution of his or her duties or suffers from any infirmity likely to be detrimental to the efficient discharge of his or her duties, the Principal Inspector of Mines may suspend or Cancel the blasting certificate.

Question 24

Does the holder of a blasting certificate of which his or her certificate has been cancelled or suspended, have a right to appeal against such decision?

Answer **[MA Regulation 29.3]**

Yes, the holder of a blasting certificate can appeal against the decision to suspend or cancel the blasting certificate to the Chief Inspector of Mines.

5.2 SURFACE MINE PRACTICES AND PROCEDURES

Question 1

What are the requirements of the Code of Practice at your mine to prevent falls of ground?

Answer **[MHSA Section 9(2) and Code of Practice]**

The employer must implement a Code of Practice of to combat slope instability related accidents in surface mines.

Question 2

What action must the miner take if attempts to take down ground is unsuccessful?

Answer **[Code of Practice]**

The ganger or miner in charge shall not allow any person to enter, work or remain where he may be endangered by ground which, to his knowledge, any person has attempted to take down or remove until such ground has been made safe.

Question 3

Name six causes of fall of ground accidents.

Answer

Inspections incorrectly done

- a) High-wall dressing not done correctly
- b) Hazard identification not to standard
- c) Working under dangerous high walls
- d) Insufficient clearance of edge
- e) Unstable geological conditions
- f) Poor blasting practices

Question 4

Name at least four (4) factors which can lead to some joints being more unstable than others.

Answer

Any of the following:

- a) Strike
- b) Dip
- c) Roughness
- d) Infill
- e) Water
- f) Spacing
- g) Continuity
- h) Nature of contact
- i) Co-efficient of friction

Question 5

Name any four types of special support used in surface mines.

Answer **[Code of Practice]**

- a) Mesh
- b) Shotcrete
- c) Cable anchors
- d) Gabions

Question 6

Explain the meaning of Rock Mechanics.

Answer

Rock Mechanics can be regarded as the study of the properties and behaviour of rock in response to the stresses and changes in stress resulting from mining operations.

Question 7

Explain the meaning of strata control.

Answer

Strata control is the mechanism(s) used to control the immediate rock surrounding an excavation.

Question 8

Explain the meaning of deformation.

Answer

If a body is prevented from moving the applied force will cause deformation or change the shape of the body (elastic movement).

Question 9

Explain the meaning of displacement.

Answer

This is the distance a body will move if a sufficient force is applied. It is normally permanent movement (inelastic movement).

Question 10

Explain the meaning of rock fracture.

Answer

Fracture is the formation of planes of separation in the rock material. It involves the breaking of bonds to form new surfaces.

Question 11

How must an open cast mine be protected against flooding?

Answer**[MHSa Regulation 14.4 and Code of Practice]**

The employer must take reasonable measures to ensure where the condition at any working place pose of might pose a significant risk to the health and safety of persons resulting from an ingress of water or other fluid material likely to cause drowning or inundation or being trapped, that all working places are adequately protected from such ingress of water or other fluid material. Reasonable measures such as storm water trenches and embankments must be established to prevent flooding of the workings.

5.3 SURFACE MINE MACHINERY**Question 1**

What are the employer's duties regarding the installation, operation, maintenance and patrolling of a belt conveyor system used in a confined space on a mine?

Answer**[MHSa Section 9(2) and Code of Practice]**

The employer must implement a Code of Practice for the safe use of conveyor belt installations for the transportation of mineral, material or personnel.

Question 2

What do the regulations require regarding stopping a belt conveyor?

Answer **[MHSa Regulation 8.9(1)(c)&(d)]**

In compliance with regulations 8.8(8) the employer must ensure that:

- a) The driving machinery of the conveyor belt installation can be stopped by any person from any point, along its length where access to the belt is possible.
- b) The driving machinery of the conveyor belt installation is stopped should the belt break, jam or slip excessively.

Question 3

What are the requirements of the regulations regarding fire-fighting equipment on or around the moving parts of any belt conveyor?

Answer **[MHSa regulation 8.9(3)]**

The employer must take reasonable practicable measures to prevent persons from being exposed to flames, fumes or smoke arising from a conveyor belt installation catching fire, including instituting measures to prevent, detect and combat such fires.

Question 4

Name the components of a belt conveyor and feeder installation and list the items you would check when examining each component.

Answer

1	<p>DRIVE UNIT</p> <ul style="list-style-type: none"> a) The motor is not overheating b) Gearbox oil levels c) Ammeter reading for overloading of motor d) Cleanliness e) Lock-out switch is operative f) Guards in position
2	<p>BELT</p> <ul style="list-style-type: none"> a) For cleanliness under the belt b) For any tears in the belt c) That splices are in order d) That fasteners are in order e) For any holes in belt f) For belt slipping g) If belt is running off line h) For wear on belt edges from rubbing against steel work, etc.
3	<p>STRUCTURE</p> <ul style="list-style-type: none"> a) That structure trestles are on line and standing vertical b) That structure pipes are straight and secure c) For sticking idlers d) For worn idlers e) For noisy idlers f) For loose idler frames g) For rusted structure
4	<p>TAIL PULLEY UNIT</p> <ul style="list-style-type: none"> a) For cleanliness under unit b) That spill plates are in place and operational c) That guards are in place and correctly installed d) Lock-out switch is operative

5	<p>FEEDER</p> <ul style="list-style-type: none"> a) That the area is adequately illuminated b) That sprays are in good working order c) For cleanliness at tail-end and underneath the feeder and belt conveyor d) That adequate guards are in position e) That scraper on bottom belt is operative f) That the flight chain is in good condition g) That the emergency stop devices are operative h) That the lockout switch is operative i) That the necessary equipment is available and in good condition, i.e. long handled scraper, broom, shovel and sledge hammer
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Question 5

What is the requirement regarding dust allaying where rock, coal or other mineral is discharged?

Answer **[Code of Practice]**

The employer must implement a Code of Practice for an Occupational health programme on personal exposure to airborne pollutants. Such code of practice must include the following measures:

- a) Where rock, coal or other mineral is discharged into any main bin, ore-pass or at any transfer point of a conveyor belt or of an ore-pass system, a constant supply of clean water shall be applied by means of efficient atomisers or sprays which shall be kept in good working order at all times, or a dust extraction system shall be provided and operated, to prevent the escape of dust into the air while rock, coal or other mineral is being discharged into the openings of such bins or ore-passes or at transfer points.

Question 6

What precautions must be taken before work may commence on a belt conveyor or before any guard may be removed?

Answer **[MHSR Regulation 8.9(1)(b)]**

In compliance with regulation 8.8(1) the employer must ensure that the power supply and all sources of stored energy of a stationery conveyor belt installation are isolated, made safe and locked out during either repairs, maintenance or cleaning of spillage in the designated sections, provided that the alignment and training of a conveyor belt installation may be carried out whilst the belt is in motion, subject to it being carried out in accordance with a procedure prepared and implemented for this purpose.

Question 7

State the causes and solutions for the following possible problems that may be encountered on a belt conveyor:

- a) One section of belting runs off to one side all along the conveyor
- b) Belt running off at head pulley
- c) Belt running off at tail pulley
- d) Fasteners pull out of belt

Answer

- a) One section of belting runs off to one side all along the conveyor

CAUSE	SOLUTION
i. One or more idlers not at right angles to longitudinal centre-line of belt	i. Advance the end of the idler to which the belt has shifted in the direction of belt travel
ii. Conveyor frame not lined up properly; or idler stand, or stands not centred on belt	ii. Stretch line along edge to determine how much out of line and correct
iii. Sticking idlers	iii. Replace, or free idler
iv. Structure not level and belt tends to climb to the high side	iv. Level structure
v. Build-up of material on idlers	v. Improve maintenance
	vi. Install scrapers

b) Belt running off at head pulley

CAUSE	SOLUTION
i. Head pulley, or troughing idlers approaching the head pulley, out of alignment	i. Check alignment of pulley and adjacent troughing idlers

c) Belt running off at tail pulley

CAUSE	SOLUTION
i. Build-up of material on return idlers and/or on pulley	i. Remove material, ensure better housekeeping
ii. Return pulley out of line	ii. Adjust at right angle to frame
iii. Unequal loading	iii. Adjust loading chute, to properly centre the load on belt

d) Fasteners pull out of belt

CAUSE	SOLUTION
i. Tension too high	i. Decrease tension
ii. Wrong type fasteners, or fasteners not tight	ii. Select correct fasteners for the duty. Tighten fasteners as prescribed, incorporating anti-ripple fastener tape
iii. Terminal pulleys too small	iii. Select the correct fastener and type of splice for the conveyor, taking the smallest pulley diameter into consideration
	iv. Use more accelerating steps in starting
	v. Control feed (feeders) at loading points

Question 8

How often and by whom are pressure vessels tested and certified?

Answer

[MA Regulation 23.12.3(b)]

Annually by the appointed Engineer.

Question 9

What prevents an electrical machine with an umbilical cable from becoming alive if the cable loses a phase?

Answer

[MHSA Regulations 3.16]

Adequate electrical protection must be provided (earth leakage).

Question 10

At a mine what legal responsibility do you have as a manager with regards to electrical sub-stations and overhead lines?

Answer

[MA Regulations 2.13.1 and 2.13.2]

Appoint an engineer in terms of Regulation 2.13.1 or a competent person in terms of Regulation 2.13.2 who should then ensure that the overhead lines and electrical sub-stations are adequately safeguarded.

Question 11

What precautions are required to be taken and what notices are required to be displayed at all sub-stations to prevent injuries?

Answer**[MHSa Regulation 3.6]**

The employer must take reasonable practicable measures to ensure that the area in which a substation is located is clearly demarcated and that notices are displayed at every point of entry of such an area. This notices must:

- a) Prohibit access of any unauthorised person from accessing that area;
- b) Set out the procedures to be followed in the event of a fire;
- c) Set out the first aid treatment measures to be given to persons suffering from the effects of electric shock and burns;
- d) Indicate the presence of electricity;
- e) Describe measure to safely remove any person incapacitated as a result of contact with electricity; and
- f) Have available and effective means of communication.

Question 12

What braking system needs to be fitted on a mobile machine that works on an incline and how often does it need to be inspected?

Answer**[MHSa Regulation 8.10.7, MHSa Section 9(2) and TMM guideline]**

- a) The employer must take reasonably practicable measures to ensure that persons are prevented from being injured as a result of brake failure such measures must include insuring:
 - i. Trackless mobile machines are operated with adequate and effective breaking systems;
 - ii. All breaking systems are adequate and routinely tested for intended functionality and
 - iii. All breaking systems are regularly maintained; and that where a combined breaking system is used, the design of the breaking system is such that in complies with the requirements for the separate systems and that it FAILS to SAFE.
- b) In order to ensure that the breaking systems of TMM's are appropriate for specific circumstances on the mine, the COP must describe per type and model of TMM, the types, design, methods of application and combinations of breaking systems installed. The following breaking systems must be installed;
 - i. Service Break
 - ii. Park brake
 - iii. Emergency Brake
 - iv. Or a combination of the above

Question 13

How does the manager ensure that his operators are competent to operate a machine and what training do they need to receive?

Answer**[MHSa Section 10 and MA Regulations 2.10.2]**

- a) Each employer must provide employees with any information, instruction, training or supervision that is necessary to enable them to perform their work safely and without risk to health and ensure that every employee becomes familiar with work related hazards and risks and the measures that must be taken to eliminate and minimise those hazards and risks
- b) The manager must ensure that no incompetent or inexperienced workmen are employed on dangerous work.

Question 14

What is the minimum illumination requirement for any vehicle operating on a mine after dark?

Answer**[MHSa Regulation 8.10.14 and MHSa Section 9(2); TMM Guidelines]**

- a) The employer must take reasonable practicable measures to ensure that trackless mobile machines, skis mounted machinery and trailers are visible to persons in their vicinity.
- b) In order to ensure that trackless mobile machines are visible to persons and to enable the operator to identify the presence of persons and hazards timely, the COP must describe at least the following illumination provisions on trackless mobile machines;
 - i. Light intensity, type, Numbers, Size, Spread and Range of light beams

- ii. The distinction between front, rear and side lights including colour coding
- iii. Positioning of lights to indicate the width of the TMM
- iv. Installation and adjustment of lights
- v. The use and position of reflectors
- vi. Procedure in case of luminaire or lamp failure.
- vii. The use of adjustable lights to illuminate places critical to safe operations

Question 15

How often do vehicles require to have their brakes tested prior to entering the mine and whose responsibility is this?

Answer

[MHSR Regulations 8.10.7]

The employer must take reasonable practicable measures to ensure that persons are prevented from being injured as a result of brake failure and such measures must include ensuring that all braking systems are adequately and routinely tested for intended functionality. At least once a shift and by the operator of the vehicle preferably at the commencement of the shift.

Question 16

Where would the responsible person go about testing brakes before vehicles enter a mine?

Answer

[TMM Code of Practice]

On a ramp provided for the purposes in a safe position.

5.4 INTRODUCTION TO EXPLOSIVES

Question 1

What is the definition of “explosives”?

Answer

[MHSR Regulation 4; “Definitions”]

- a) A substance, or a mixture of substances, in a solid or liquid state, which is capable of producing an explosion;
- b) A pyrotechnic substance in a solid or liquid state, or a mixture of such substances, designed to produce an effect by heat, light, sound, gas or smoke, or a combination of these, as the result of non-detonative self-sustaining exothermic chemical reaction, including pyrotechnic substances which do not evolve gases;
- c) Any article or device containing one or more substances contemplated in paragraph (a); or
- d) Any other substance or article which the relevant Minister may from time to time by notice in the Gazette declare to be an *explosive* in terms of the *Explosives Act, Act No 15 of 2003*.

Question 2

What is the definition of “Pumpable explosives”?

Answer

- a) A mixture of ammonium nitrate, with or without other inorganic nitrates, with combustible substances which are not , classified as UN Number 0082, Class 1.1D; or
- b) A mixture of ammonium nitrate, with or without other organic nitrates, partially or wholly dissolved in water and with the addition of any of the following:
- c) Ammonium nitrate emulsions, gels and suspensions, intermediate for *blasting*, classified as UN Number 3375;
- d) Combustible substances which are not *explosive*; or
- e) Substances which control the density of the final mix, either by chemical reaction or mechanically, and the final mix is classified as UN Number 0241, Class 1.1D; or
- f) Any form of *explosive* which is inserted in a hole by means of pumping.

Question 3

What is the definition of a “Primer”?

Answer**[MHTA Regulation 4; “Definitions”]**

Is an *explosive* cartridge or booster into which a detonator or detonating fuse has been inserted or connected.

Question 4

Name four factors that influence the selection of an explosive.

Answer

Any of the following:

- a) Physical characteristics, e.g. bulk, packaged
- b) Water resistance
- c) Density
- d) Sensitivity
- e) Critical diameter
- f) Velocity of detonation
- g) Strength of energy
- h) Post detonation fumes
- i) Susceptibility to desensitisation
- j) Storage life
- k) Temperature effects
- l) Cost

Question 5

Why is explosive density important?

Answer

The amount of explosive that is required per blast hole is dependent on the density (the less the density, the more explosive is required) and also where there is water in the blast holes, the density will determine whether the explosive will float or sink.

Question 6

What effects does temperature have on an explosive?

Answer

- a) High temperature – increases the risk of burning or exploding because initiation sensitivity generally increases with temperature.
- b) Low temperature – decreases sensitivity but not enough to cause failure to detonate under normal conditions. In cold climates, such as Canada in winter, special low temperature formulations are used.

Question 7

What is the most serious disadvantage of ANFO?

Answer

ANFO is very soluble in water and it is quickly rendered inert in wet blast holes. Low density ANFO can cause charging difficulties in certain conditions.

Question 8

Name four reasons why accidents take place when working with explosives.

Answer

Any of the following:

- a) A lack of respect for explosives

- b) When people are in a hurry
- c) When there is a change of routine
- d) Through ignorance
- e) Ignoring regulations and procedures
- f) When people stop thinking

Question 9

What is the added danger of cellular telephones?

Answer

They are continually transmitting radio frequency energy when switched on, *even when not being used*.

5.5 TRANSPORT, STORAGE AND SECURITY OF EXPLOSIVES

Question 1

In what sequence must explosives be used?

Answer

[MHS Regulation 4.3(2)(a)]

All *explosives* must be used in the same sequence as they are issued.

Question 2

Name the responsibilities of a person transporting explosives.

Answer

[Code of Practice]

- a) Count cases or containers issued from magazine.
- b) Ensure diligence and security of transport to proper destinations.
- c) Count number of cases or containers delivered.

Question 3

Name precautions to be taken when explosives are loaded or off-loaded.

Answer

[MHS Regulations 4.17(2)]

- a) No loading within 10m of fire.
- b) No smoking or producing a naked flame within 10m of where explosives are being off-loaded.

Question 4

What are the provisions governing the transport of explosives on surface on the mine?

Answer

[MHS Regulation 4.2(1)(b)(vi)]

The employer must ensure that every container used for the storage of explosives, including old explosives is approved in writing for that purpose by the Employer.

Question 5

Name three important things about vehicles containing explosives.

Answer

[Code of Practice]

- a) They should never be left unattended
- b) They should never be overloaded
- c) They should only contain sufficient explosives for the job at hand

5.6 BASIC BLASTING DESIGNS

Question 1

Name two things that need to be considered when selecting a bench height.

Answer

- a) The face height should match the blasthole diameter
- b) The drill rod length should be taken into account
- c) Drilling accuracy becomes more critical and difficult for high faces
- d) The size of the loading equipment
- e) Rock and geological characteristics

Question 2

What is the purpose of stemming and tamping?

Answer

- a) To prevent flyrock
- b) To enhance fracture and displacement of rock by containing heave(gas) energy

Question 3

Name four categories of environmental effects.

Answer

- a) Ground vibration
- b) Airblast and noise
- c) Flyrock
- d) Air pollution – dust and gases

Question 4

According to USBM standards, what is the minimum acceptable noise level during blasting?

Answer

128 dB

5.7 BLASTING PROCEDURES

Question 1

When may more than one detonator be used in a charge?

Answer

[MHTA Regulation 4.16(8)(d)]

More than one detonator may be used if it is necessary to re-initiate a *misfired hole* provided that in wet workings two detonators may be used only if they are both inserted into the same cartridge and securely fastened to it.

Question 2

What precautions must the miner take where firing takes place by means of electricity?

Answer

- a) The employer must take reasonable measures to ensure that, where initiating takes place by means of electricity, the competent person referred to in regulation 4.4(1), after such competent person has connected the blasting cable to the detonator wires of any explosive charge or charges and before such explosive charge or charges have been initiated, does not:

- i. Remain or approach, or cause or permit any other person to remain or approach, within a distance where such person may be endangered by the initiating of such explosive charges, except for the purpose of examining the blasting circuit; and
 - ii. Examine the blasting circuit, or cause or permit the blasting circuit to be examined, unless both leads are disconnected from any source of electricity, whether for initiating explosive charges or testing the blasting circuit.
- b) The employer must, where initiation takes place by means of electricity, take reasonable measures to ensure that the competent person referred to in regulation 4.4(1):
- i. Only uses a blasting cable provided for that purpose and which is in good order and of sufficient length to ensure that the blasting cable cannot come into contact with any other cable or electrical apparatus;
 - ii. Secures the initiating device of the blast in an adequate and reasonable manner so as to prevent unauthorised access or use of the blasting system;
 - iii. Connects the blasting cable to the detonator wires of any explosive charge or charges or to the wires of the initiator or similar device only after completing all blasting precautions, other than those referred to in paragraphs (d), (e) and (g) of this regulation;
 - iv. Does not apply any electrical test to the blasting circuit except through the blasting cable and from a place of safety;
 - v. Does not connect the blasting cable to the terminals of the initiating device until immediately before initiation of explosive charges or attempting to initiate the explosive charges;
 - vi. Except in the case of a remotely operated centralized electric blasting system, immediately after initiating or attempting to initiate the explosive charges, disconnects both leads of the blasting cable from the initiating device and then:
 - Removes the operating handle or key of the initiating device; or
 - Secures the locking arrangement of the initiating device and removes the key;
 - In the case of a remotely operated centralized electric blasting system, does not connect the blasting cable to the terminals of the blasting box until immediately before leaving such competent person's working place at the end of the shift; and
 - In the case of a remotely operated centralized electric blasting system, disconnects immediately at the commencement of the shift any blasting cable from the terminals of the blasting box;
- c) The employer must take reasonable measures to ensure that, after the explosive charges have been initiated by means of electricity, the competent person referred to in regulation 4.4(1):
- i. Carefully examines for misfired holes where the charges have been initiated, before permitting any person to work there;
 - ii. Instructs any person engaged in clearing the broken rock, mineral or ground to report immediately to such competent person the finding of any wires that may lead to a misfired hole; and
 - iii. Carefully traces any such wires to determine whether or not a misfired hole has occurred.
- d) The employer must take reasonably practicable measures to ensure that where the initiation of explosives takes place by means of electricity and where there is a risk of an explosive charge being initiated by lightning, operations in connection with the preparation or initiation of explosive charges are not started or continued on the approach of or during a thunderstorm and that no person remains, or is caused or permitted by any other person to remain, within an area where any person may be injured by the accidental initiation of explosives.

Question 3

What precautions are taken after firing cable has been connected to detonator wires?

Answer

[Code of Practice]

- a) Nobody to be within an unsafe distance except for purpose of examining firing circuit or;
- b) For the purpose of examining the firing circuit but with both leads disconnected from source of electricity.

Question 4

Which holes must be stemmed and what stemming material must be used?

Answer **[MHSa Regulation 4.14]**

- a) All holes charged with explosives must be stemmed and tamped.
- b) Stemming material used must be determined by the employer in consultation with the explosives manufacturer or supplier.

Question 5

What must you do before firing an explosive charge not contained in a shot hole?

Answer **[Code of Practice]**

Completely cover the charge with mud, clay or other non-inflammable material determined for that purpose by the employer in consultation with the explosive manufacturer or supplier.

Question 6

What are the duties of the miner before firing explosive charges?

Answer **[MHSa Regulation 4.6(5)]**

The *employer* of every surface *mine* must take reasonable measures to ensure that:

- a) No person remains or approaches, or is caused or permitted to remain or approach, within 15 metres of any *shot hole* being charged with *explosives*, unless such person is assisting in the charging up of *shot holes* with *explosives*;
- b) Except with the written permission of the principal inspector of *mines explosives* are not brought to the *working place* where *blasting* is to be carried out until the *shot holes* are ready to be charged with *explosives* and the quantity of *explosives* brought to the *working place* do not exceed the estimated required quantity;
- c) Before the initiation of *explosive* charges, an adequate number of guards are stationed at a safe distance *determined* by a *risk* assessment to prevent persons accessing the *blasting* area and that the guards remain at the safe distance until the initiation of *explosive* charges is completed and the guards are recalled by the competent person referred to in *regulation 4.4(1)*; and
- d) At least three minutes before an *explosive* charge is initiated, the competent person referred to in *regulation 4.4(1)* gives due warning of the initiation of explosive charges.

Question 9

What must be done with explosives found amongst the rocks or explosives recovered from misfires?

Answer **[Code of Practice]**

It must immediately be placed in the non-metallic boxes provided by the employer. Blasting cartridges and detonators (or other initiators) to be placed in separate boxes.

Question 10

- a) How would you know when explosives are frozen and;
- b) What would you do with it?

Answer

- a) The explosives will be hard and in some cases, crystallised on outside.
- b) Allow to thaw slowly in a safe place, warmed by the sun.

Question 11

How may you test a circuit containing an electric detonator?

Answer **[MHSa Regulation 4.16(8)(e)]**

The Miner must only uses a means, appliance or material supplied by the employer for the purpose of initiating of explosive charges or testing of a blasting circuit.

Question 12

What precautions should you take in a surface mine where firing takes place by means of electricity when a thunderstorm is approaching?

Answer **[MHS Regulation 4.10(4)]**

The *employer* must take *reasonably practicable* measures to ensure that where the initiation of *explosives* takes place by means of electricity and where there is a *risk* of an *explosive* charge being initiated by lightning, operations in connection with the preparation or initiation of *explosive* charges are not started or continued on the approach of or during a thunderstorm and that no person remains, or is caused or permitted by any other person to remain, within an area where any person may be injured by the accidental initiation of *explosives*.

Question 13

How far must persons not assisting with charging of holes, remain from the miner?

Answer **[MHS Regulation 4.6(5)]**

The *employer* of every surface *mine* must take reasonable measures to ensure that no person remains or approaches, or is caused or permitted to remain or approach, within 15 meters of any *shot hole* being charged with *explosives*, unless such person is assisting in the charging up of *shot holes* with *explosives*;

Question 14

When may explosives be brought to the working place and how many?

Answer **[MHS Regulation 4.6(5)(b)]**

The employer of every surface mine must take reasonable measures to ensure that except with the written permission of the Principal Inspector of Mines explosives are not brought to the working place where blasting is to be carried out until the shot holes are ready to be charged with explosives and the quantity of explosives brought to the working place do not exceed the estimated required quantity.

Question 15

How must holes deeper than 3 meters be primed?

Answer **[Code of Practice]**

With detonating fuse which shall extend to bottom of the charge and protrude 150mm outside the hole.

Question 16

What precautions must be taken before any charge is fired?

Answer **[MHS Regulation 4.6(5)(c) and (d)]**

The employer of every surface mine must take reasonable measures to ensure that:

- a) Before the initiation of explosive charges, an adequate number of guards are stationed at a safe distance determined by a risk assessment to prevent persons accessing the blasting area and that the guards remain at the safe distance until the initiation of explosive charges is completed and the guards are recalled by the competent person referred to in regulation 4.4(1); and
- b) At least three minutes before an explosive charge is initiated, the competent person referred to in regulation 4.4(1) gives due warning of the initiation of explosive charges.

Question 17

What precautions must be taken before allowing persons to enter or approach the place where blasting has taken place?

Answer **[MHS Regulation 4.9]**

The *employer* must take reasonable measures to ensure that after *explosive* charges have been *initiated* or *misfired holes* have been *re-initiated*, the competent person referred to in regulation 4.4(1) does not approach,

or causes or permits any other person to approach, within the range of the exploding charges until such competent person is satisfied that all the *explosive* charges have exploded or until a period of 30 minutes has expired, after the *initiation* of the charges.

Question 18

What precautions must be taken by a person extracting explosives from a hole?

Answer [MHTA Regulations 4.11(4)(a) and (b)]

The person extracting *explosives* from a *misfired hole*:

- a) Ensures as far as *reasonably practicable* that all the *explosives* in the *misfired hole* are extracted; and
- b) Recovers all *explosives* that have been extracted from the *misfired hole*.

Question 19

What precautions must be taken before marking holes?

Answer [MHTA Regulation 4.12(2)(a)]

In surface *mines*, before the Miner/Ganger points out or marks any *shot hole* for drilling or authorizes any other person to point out or mark the position and direction of any *shot hole* for drilling, such competent person searches for any *misfired hole* or *socket* within a distance of at least two meters from the proposed position or mark.

Question 20

How do you mark holes?

Answer [Code of Practice]

Mark clearly with paint, etc. or if impracticable point out position and direction of hole and no hole must be marked nearer than 150mm from a socket or 2 meters from a misfired hole.

Question 21

What precautions must be taken when working in trenches or near highwalls?

Answer [MHTA Regulations 7.9.1(a) and (b)]

- a) Never undercut the face or sidewall or portion of a dump, dam or heap.
- b) The face or sidewall above the level where persons may work must be sloped or terraced at a safe angle or adequately supported where the vertical height is:
 - i. Three meters or more, or
 - ii. Less than three meters but more than 1,5 meter if the width of the working is less than the height of the face or sidewall

Question 22

What general precautions must be taken to prevent fly-rock?

Answer [Code of Practice]

- a) Ensure that stemming is equal to or more than your burden.
- b) Stemming must be tamped with a wooden stick where practical (stick's end must be flat).
- c) Correct tie-in of pattern must be used to prevent "boxing".
- d) Overcharged holes explosives must be removed.

Question 24

How should old explosives be destroyed?

Answer**[MHTA Regulation 4.2(3)]**

- a) The *employer* must ensure that a written procedure is prepared and implemented, after consultation with the *explosive* manufacturer or supplier, to ensure that *explosives* are destroyed safely and not re-used for any purpose. Such procedure must include measures to ensure that:
- i. Only the competent person (Miner/Ganger) destroys *explosives*;
 - ii. The Chief Inspector of Explosives is informed in advance if more than 50kg of *explosives* are to be destroyed at any one time; and
 - iii. No person destroys *explosives* on surface within a horizontal distance of 150 meters of any public building, public thoroughfare, railway line, power line or any place where people congregate or any other structure, which it may be necessary to protect in order to prevent any significant *risk*, unless:
 - A *risk* assessment has identified a lesser safe distance and any restrictions and conditions to be complied with;
 - A copy of the *risk* assessment, restrictions and conditions contemplated, in paragraph (a) have been provided for approval to the Principal Inspector of *Mines*;
 - Written permission has been granted by the Principal Inspector of *Mines*; and
 - Any restrictions and conditions *determined* by the Principal Inspector of *Mines* are complied with.
- b) Not more than 5 kg of explosives can be destroyed at one time:
- i. Dig a hole 2 meter deep.
 - ii. Place the old explosives into it with a new primer firmly attached to the old explosive.
 - iii. Fill the hole with sand.
 - iv. Follow the laid down blast procedure.
 - v. Fire the charge and
 - vi. After a period of 30 minutes examine whether the old explosive has been destroyed.
- c) Old explosive can also be destroyed by tying them into the blast pattern in an opencast mine. Cover with an adequate amount of sand to avoid noise vibration.

Question 25

What is the disadvantage when blasting secondary boulders which are at the toe position of a primary blast?

Answer**[Code of Practice]**

- a) The secondary boulders could create cut-offs on the primary blast; or
- b) The primary blast could create cut-offs between the boulders, which will create misfires and the misfires will be covered by the muck from the primary blast.

Question 26

Name the seven important points that apply when electric detonators are used for blasting.

Answer**[Code of Practice]**

- a) Test the detonator circuit for continuity with an approved tester
- b) Test the electric cables for continuity
- c) The blaster must keep the handle/key from the firing apparatus on his person
- d) The blaster must make all the electric connections personally
- e) The electric firing cable to be of sufficient length
- f) Do not connect the firing cable to the shot exploder until immediately before firing the charges
- g) After the blast, disconnect the electric firing cable from the shot exploder and short the wires out

Question 27

May a hole, which was not drilled to its correct depth, be drilled deeper by the next shift?

Answer**[MHTA Regulation 4.12(2)(c)(iii)]**

No person deepens or causes or permits any other person to deepen any shot hole that has been left standing or which has not been completed at the end of a shift, unless it has not been charged with explosives and has

been clearly described by the competent person referred to in *regulation 4.4(1)* in charge of the shift leaving work to the competent person referred to in *regulation 4.4(1)* in charge of the shift about to commence.

Question 28

Name the important properties and use of a shot exploder.

Answer

[Code of Practice]

- a) A removable handle
- b) A serial number
- c) Must be kept in a safe place
- d) The shot exploder must have sufficient capacity to fire the intended number of blast holes
- e) Approved by the employer in consultation with the explosives manufacturer or supplier

Question 29

In open cast mines there is normally a safe distance where flag men/women are positioned to guard the entrances to the blasting area. What can influence the responsible person to increase or decrease the blast clearance distance?

Answer

[Code of Practice]

The clearance distance can be increased if there:

- a) Are overcharged holes
- b) Is insufficient burden on crest holes
- c) Is a presence of wind

The clearance distance can be decreased:

- a) If there is a very small amount of explosive charge to be initiated.
- b) When the explosive charge is heavily covered with sand and the possibility of fly rock is zero.

The employer in consultation with the explosive manufacturer must conduct a risk assessment to determine a safe clearance distance.

Question 30

Name the three major factors that affect the magnitude of drilling deflection.

Answer

- a) Structural geology
- b) Angle of drilling
- c) Stiffness of the drill string (stabilizers)

Question 31

Why is a sub-drill used?

Answer

A sub-drill is used to ensure an even bench floor.

Question 32

Name six factors on which drilling patterns are dependent.

Answer

- a) Blast-hole diameter
- b) Rock properties
- c) Degree of fragmentation required
- d) Displacement required
- e) Height of the face
- f) Explosive properties

Question 33

Name five requirements for a suitable site to destroy explosives by detonation.

Answer

- a) It should be remote from all people, roads and buildings
- b) It must be an open area cleared of all vegetation that could catch fire
- c) The ground must be free of stones which might be thrown by the blast
- d) It must be possible to block or guard all access to the site
- e) A safe firing location must be available for possible projectiles

Question 34

When packages of explosives are placed out to be destroyed, may they overlap?

Answer

No they may not. They should be placed on each bed in a single layer, without overlapping.

Question 35

Name four safety factors that must be considered when destroying explosive products by burning.

Answer

- a) Do not burn more than one type of explosive at the same time
- b) Do not burn explosives if there is a strong wind
- c) Stay in a safe place until 30 minutes after all flames and smoke are completely gone
- d) If the fire goes out unexpectedly, do not return to the site until at least 30 minutes after all traces of fire and smoke are gone

Question 36

The dust and fumes from blasts can take a relatively long time to clear. What are the possible consequences if adequate time is not allowed before re-entering the blast area?

Answer

- a) Injury due to the inhalation of toxic gases and post-blast fumes
- b) Collisions, falling or tripping due to reduced visibility
- c) Inability to detect unstable rock

Question 37

What does re-firing of holes results in?

Answer

Re-firing of blast-holes almost always produce more flyrock as a result of the previous fragmentation

Question 38

What precautions must be taken to prevent to prevent danger of a fly-rock?

Answer**[Code of Practice]**

- a) Tamp to a depth at least equal to the burden of the hole.
- b) Do not undercharge or overcharge the holes with explosives.
- c) Use detonating relays or short period delays detonators.
- d) Fire the explosive charges in sequence.

5.8 PRACTICAL BLAST LAYOUTS**Question 1**

What is the spacing to burden ratio for smooth blasting?

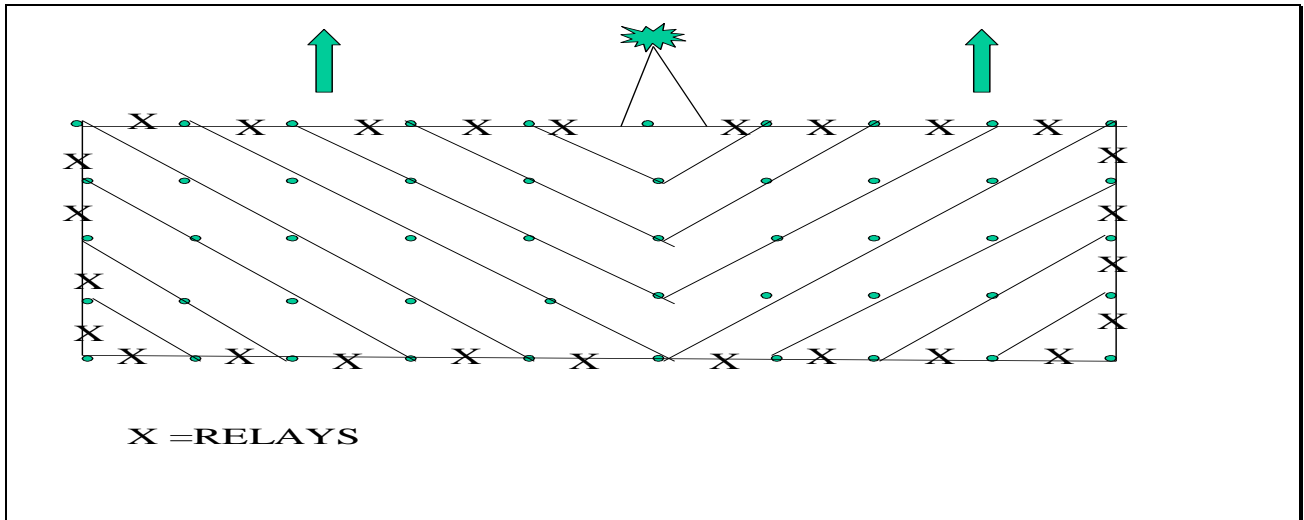
Answer

S=0.8B

Question 2

- a) Sketch a plan view of a Blast plan with FIVE rows and TEN holes per row.
- b) Indicate firing order by using a V1 pattern to tie-up the blast using detonating cord.
- c) Indicate the position of the detonator relays or delays.
- d) Show initiation point and the sequence of firing.

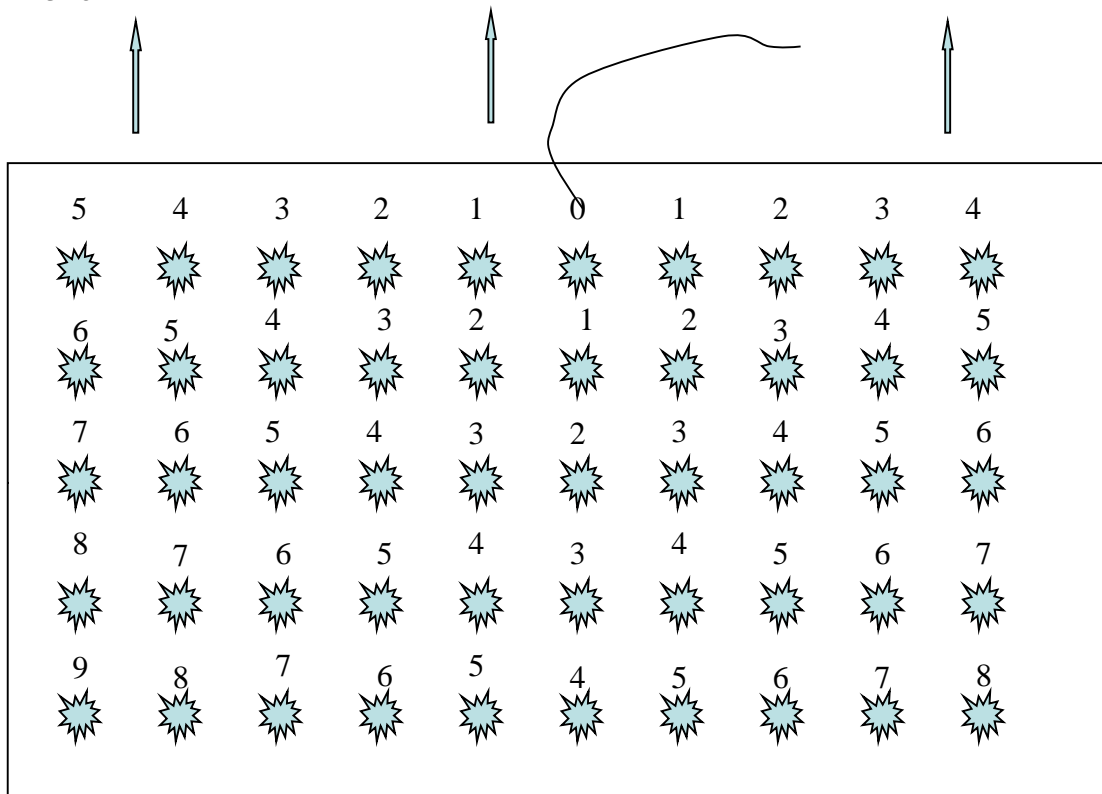
Answer

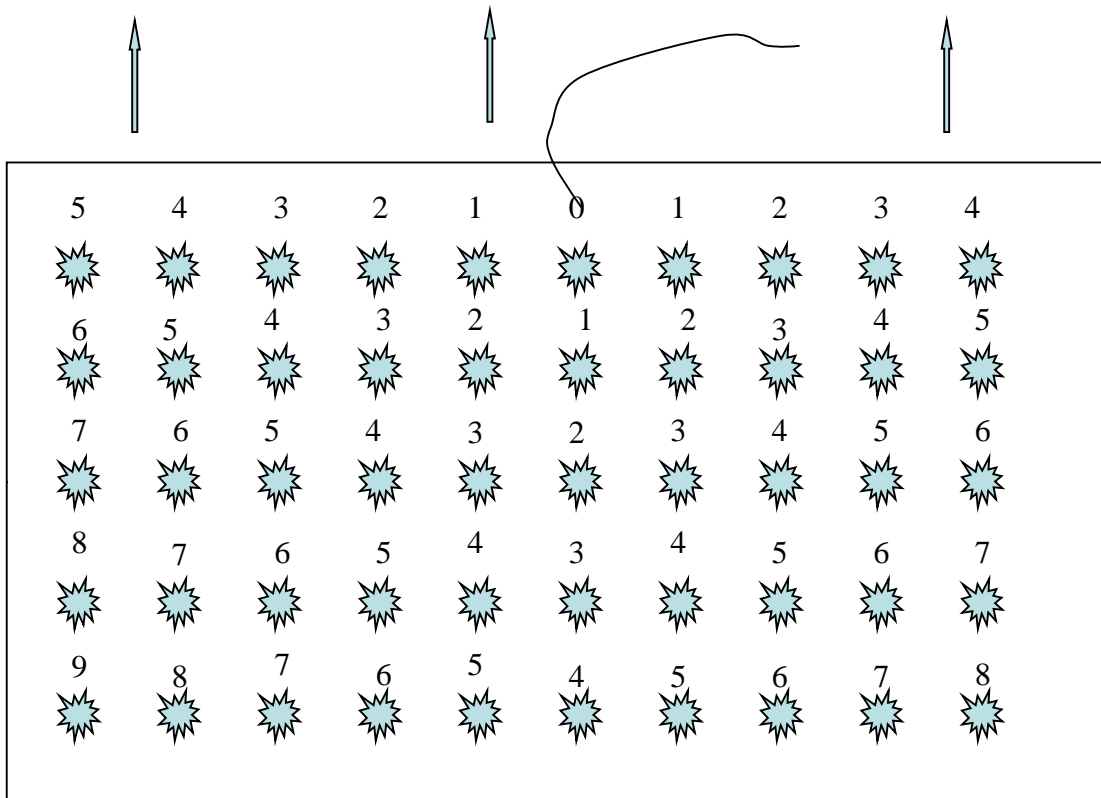


Question 3

- a) Sketch a plan view of a Blast plan with FIVE rows and TEN holes per row.
- b) Indicate firing order by using a V1 pattern to tie-up the blast using Electric blast cables.
- c) Indicate the position of the relays or delays.
- d) Show initiation point and the sequence of firing.

Answer





5.9 DUST PREVENTION

Question 1

Name six causes of dust.

Answer

- Blasting operations
- Rock being broken up at tips
- Loading and transporting of broken rock
- Tipping of ore and waste rock
- Haul roads
- Drilling
- Crushing and screening

Question 2

Name five ways in which the inhalation of dust can be prevented?

Answer

- Wetting of dusty surfaces and ground where any work is to be performed
- Not use a drill rig unless the means provided for allaying dust is in good working order
- Not enter blasted areas before expiry of re-entry period
- At tipping point and transfer points, atomisers, sprays or dust extraction systems must be provided
- Wear appropriate dust protective device or equipment.

Question 3

Where is dust likely to be generated and how can this be controlled?

Answer

Where rock or other mineral is reduced in size, moved or handled in such a way that it will produce dust:

- a) Prevent generation of dust at source
- b) Prevent liberation of dust at source
- c) Wear appropriate dust protective device or equipment.

SECTION 6

QUESTIONS AND MODEL ANSWERS

CHOICE QUESTIONS

6.1 SURFACE MINE LEGAL KNOWLEDGE AND APPLICATION

Question 1

List the employer's responsibilities with regard to health and safety at the mine.

Answer [MHTA Sections 5, 6, 7, 8, 10, 11, 13 and 17]

- a) Maintain a healthy and safe mine environment;
- b) Ensure an adequate supply of health and safety equipment;
- c) Staff the mine with due regard to health and safety, i.e. ensure that all employees are suitably qualified, trained and supervised;
- d) Establish a health and safety policy for the mine in consultation with employees;
- e) Provide health and safety training to employees;
- f) Identify hazards to health and safety and take appropriate corrective action;
- g) Establish a system of medical surveillance of employees exposed to health hazards and keep a record for each employee;
- h) Arrange for an exit medical examination for each employee that leaves his/her employment and provide him/her with a copy of the exit certificate.

Question 2

Name three important rights with regard to safety and health that the Act grants to mine employees.

Answer [MHTA Sections 19, 23 and 24]

- a) The right to Information
- b) The right to leave a dangerous working place
- c) The right not to pay for safety measures

Question 3

How is a safety representative appointed?

Answer [MHTA Regulation 6.9(a)]

In writing by the manager, after being elected by the employees.

Question 4

What is the purpose of the Mining Qualifications Authority?

Answer [MHTA Section 41(3)]

The Mining Qualification Authority was established to advise the minister on training and qualifications in the mining industry.

Question 5

Define the following terms:

- a) Medical Inspector
- b) Department
- c) Health
- d) Healthy
- e) Health and safety committee

- f) Occupational Hygiene
- g) Working Place

Answer **[MHSA Section 102]**

- a) "*Medical Inspector*" means a medical inspector appointed in terms of section 49(1)(b) of MHSA
- b) "Department" means the Department of Mineral Resources
- c) "*Health*" refers to occupational health at mines
- d) "*Healthy*" means free from illness or injury attributable to occupation causes
- e) "*Health and safety committee*" means a health and safety committee established in terms of section 34 of MHSA
- f) "*Occupation hygiene*" means the anticipation, recognition, evaluation and control of conditions at the mine, that may cause illness or adverse health effects to persons
- g) "*Working place*" means any place at a mine where employees travel or work

Question 6

State the employer's duties with regard to the medical examination of an employee leaving the employment of the mine.

Answer **[MHSA Section 17]**

If an employee leaves the employment of the mine for any reason, the employer must arrange an exit medical examination of the employee. A copy of the exit certificate must be given to the employee and a copy must be entered in his record of medical surveillance.

Question 7

May mining operations be conducted within a horizontal distance of 100 metres from buildings, roads, railways, any structure whatever or any surface which it may be necessary to protect?

Answer **[MHSA Regulations 17.10]**

No, unless permission has been obtained from the Principal Inspector of Mines.

Question 8

May a road, building, railway or any structure be erected or constructed within a horizontal distance of 100 meters from the working of a mine or works?

Answer **[MHSA Regulation 17.10]**

Only with the written permission of the Principal Inspector.

Question 9

When must a person be secured with a life-line?

Answer **[MA Regulation 7.8.1]**

In any position from which the falling or slipping of such person may result in injury or when a person enters any accumulation of water or mud other than an accumulation known to be insignificant.

Question 10

May you undercut an open face?

Answer **[MA Regulations 7.9.1(a) and 7.9.1(b)]**

No, the face or sidewall of any portion of a dump, dam or heap in sand, soil, gravel, clay, tailings, slimes, ash, debris or similar ground or deposit may not be undercut unless permitted by the Principal Inspector and under such conditions as he may prescribe.

Question 11

How do you examine a socket?

Answer **[Code of Practice]**

By using a means determined by the employer after consultation with the explosives manufacturer or supplier.

Question 12

What must be done with an examined socket?

Answer **[Code of Practice]**

It must be plugged with a plug that has been supplied for that purpose by the employer.

Question 13

Can a socket be used for collaring to drill a new shot hole?

Answer

No

Question 14

How is a misfire demarcated?

Answer **[Code of Practice]**

In open cast mines or quarries, the misfired holes must be demarcated in a manner prescribed by the employer.

Question 15

What are blasting assistants not allowed to do?

Answer **[Code of Practice]**

- a) They may not be in possession of a key to an explosive box
- b) They may not initiate the explosive charges
- c) They may not operate the explosive initiating system.

Question 16

When may a person be allowed to be in possession of a key to a magazine or a store in which explosives are kept?

Answer

If the person is within sight of a holder of a blasting certificate.

Question 17

What are the requirements of dealing with a misfired hole?

Answer **[MHSR Regulations 14.11(6)]**

In all surface *mines* the competent person referred to in *regulation* 4.4(1):

- a) Re- *initiates* the *misfired hole*; or
- b) Drills or causes to be drilled in the presence of such competent person, a relieving hole not less than 150 millimeters deeper than the *misfired hole* and which relieving hole is parallel to and not nearer than one meter to the *misfired hole* and that such competent person charges and *initiates* this relieving *shot hole* and recovers the *explosives* liberated from the *misfired hole*; or
- c) Extracts the *explosives* from the *misfired hole* by a means determined for this purpose by the employer after consultation with the *explosives* manufacturer or supplier.

Question 18

What are the duties of a Blasting Assistant regarding primary and secondary blasting?

Answer **[MHSR Regulation 4.4(3)]**

The Blasting Assistant is required to assist the Miner/Ganger with the following activities:

- a) Exercising control over those explosives to be used during the performance of the duties of the Miner/Ganger as stipulated in paragraphs b), c), d) and e) below;
- b) The preparation of primers;
- c) The charging of shot holes with or the placing of explosive charges;
- d) The connecting of blasting rounds or circuits; and
- e) The handling and transportation of explosives, initiation systems and accessories.

Question 19

Which holes need not be tamped/stemmed?

Answer **[MHTA Regulation 4.14]**

All the shot holes are required to be tamped/stemmed.

Question 20

How do you blast explosives not contained in a hole?

Answer **[Code of Practice]**

Cover explosives with clay, mud or other non-inflammable material determined for that purpose by the employer in consultation with the explosives manufacturer.

Question 21

Does the re-entry period after firing the main blast differ from the re-entry period after firing a misfired hole/s?

Answer **[MHTA Regulations 4.9]**

No, both 30 minutes.

Question 22

What is the definition of a socket?

Answer **[MHTA Regulations 4 “Definitions”]**

Socket means any *shot hole*, or part of any *shot hole*, known not to be a *misfired hole*, which remains after having been charged with *explosives* and blasted or which, for any other reason, may be suspected of having contained *explosives* at any time and includes any *shot hole*, or part of any *shot hole*, from which all *explosives* have been extracted.

Question 23

What is the definition of a Ganger or Miner?

Answer **[MHTA Regulations “Definitions”]**

A person in charge of workmen.

Question 24

What is the definition of workings?

Answer **[MHTA Regulations “Definitions”]**

Any excavation of a mine made or being made for the purpose of searching for or winning minerals.

Question 25

What is the definition of a shot hole?

Answer **[MHTA Regulations 4 “Definitions”]**

Any drill hole charged with, or intended to be charged with explosives.

Question 26

What is the definition of a misfired hole?

Answer**[MHSR Regulations 4 “Definitions”]**

Misfired hole means a *shot hole* or part of a shot hole in which any *explosives* or any portion thereof has failed to explode after initiation.

Question 27

What First Aid equipment must be kept at every mine or works?

Answer**[MA Regulations 24.1.1]**

- a) A suitable stretcher
- b) 2 blankets
- c) A first aid box containing first aid kit

Question 28

What would you do if a person complains that his work place is unsafe?

Answer**[Code of Practice]**

Withdraw all workers and make it safe or have it examined by another certificated miner.

Question 29

Does sanitation have to be provided?

Answer**[MHSR Regulation 9.2(5)(c) and MA Regulations 4.11]**

- a) The employer must provide and maintain suitable, adequate and readily available latrine facilities, within a reasonable distance from each working place.
- b) No person shall pollute the workings with faeces nor wantonly misuse or foul any latrine facilities.

Question 30

If you decide not to treat a misfire immediately, what do you do instead?

Answer**[Code of Practice]**

In open cast mines or quarries, the misfired holes must be demarcated in a manner prescribed by the employer.

Question 31

May any blowpipe be used to wash misfires out?

Answer**[MHSR Regulation 4.11(3)]**

No, Explosives are only extracted from any misfired hole by a means determined for this purpose after consultation with the explosives manufacturer or supplier.

Question 32

What precautions must be taken by the person extracting explosives from a hole?

Answer**[MHSR Regulation 4.11(4)]**

Ensures as far as reasonably practicable that all the explosives in the misfired hole are extracted; and recovers all explosives that have been extracted from the misfired hole.

Question 33

How people are protected where there is a danger of either sliding or falling down a steep face?

Answer**[MA Regulations 5.8.1 and 7.8.1]**

- a) At any mine or works no person must work, or cause or permit any other person to work, in any position from which the falling slipping of such person may result in injury unless such person is where practicable secure by a life line or otherwise suitably safeguarded.
- b) No person shall work, cause, or permit any other person to work, in or near any part of the workings of a mine where inadvertent slipping or overbalancing may result in his/her sliding or falling down any slope that as an inclination from the horizontal of 45 degrees or more or, in his falling vertically, unless he is secured by a life line or otherwise safeguarded.

Question 34

How must people and equipment at the bottom of a face be protected from rocks and debris that might fall down the face?

Answer**[MA Regulations 7.9.2]**

At open face, workings or quarry all debris and other loose material and stones on the surface must be cleared at least a distance of at least 3 meters from the edge of such open workings or quarry.

Question 35

When charging with explosive cartridge, how much explosive may be at a hole to be charged at any given time?

Answer**[MHS Regulation 4.15]**

The *employer* must take *reasonably practicable* measures to ensure that the maximum amount or mass of *explosives* used per *shot hole* is according to the manufacturer's or supplier's recommendations

Question 36

When must the face or sidewall above the level where persons may work or travel be sloped or terraced back at a safe angle or adequately supported?

Answer**[MA Regulation 7.9.1(b)]**

Where the vertical height of such face or sidewall is:

- a) Three meters or more, or
- b) Less than three meters but more than 1,5 meter if the width of the adjacent working or travelling space is less than the vertical height of the face or sidewall.

Question 37

What must the width of the boundary pillar be of any opencast working?

Answer**[MHS Regulation 17.11(b)]**

Not less than 9,0 meters, measured horizontally at right angles from the boundary line.

Question 38

When must you examine for misfired holes?

Answer**[MHS Regulation 4.12(2)(a)]**

Before any competent person referred to in regulation 4.4(1) points out or marks any shot hole for drilling or authorizes any other person to point out or mark the position and direction of any shot hole for drilling, such competent person searches for any misfired hole or socket within a distance of at least two meters from the proposed position or mark.

Question 39

May you withdraw tamping from a hole?

Answer **[MHTA Regulations 4.8]**

The employer must take reasonable measures to ensure that the stemming or tamping is not withdrawn from a shot hole that has been charged with explosives except when dealing with misfired holes.

Question 40

When may you approach workings after firing charges?

Answer **[MHTA Regulations 4.9]**

Not before satisfied that all charges have exploded or the expiry of 30 minutes.

Question 41

Describe the properties of an old explosives box?

Answer **[MHTA Regulation 4.2.1(b)(i)]**

Every container used for the storage of explosives, including old explosives, is:

- a) Of robust construction;
- b) Provided with an effective lock and the key kept only by an authorized person referred to in regulation 4.1(2);
- c) Clearly marked to indicate the type of explosives to be placed therein;
- d) Of a capacity determined by the Employer in consultation with the explosive manufacturer or supplier;
- e) Spaced apart from any other container used for storage of explosives, at a distance determined by the Employer after consultation with the explosive manufacturer or supplier; and
- f) Approved in writing for that purpose by the employer.

Question 42

How far must a person smoke, lights a fire, or brings naked light or flames from explosives?

Answer **[MHTA Regulations 4.16(3)]**

No person smokes, lights a fire or brings a naked light or flame, within a distance of 10 meters of where explosives are being loaded, transported, off loaded, handled or explosive charges are being prepared.

Question 43

Who must be in possession of explosives keys for explosive storage boxes?

Answer **[MHTA Regulation 4.2(1)(b)(i)(b)]**

The explosive key must be kept only by a person authorized by the employer.

Question 44

What explosives may be used?

Answer **[MHTA Regulation 4.3(1)]**

Only explosives provided by the employer must be used at the mine.

Question 45

How far may an enclosed lamp or light be placed from explosives?

Answer **[MHTA Regulations 4.16(3)]**

No person smokes, lights a fire or brings a naked light or flame, within a distance of 10 meters of where explosives are being loaded, transported, off loaded, handled or explosive charges are being prepared.

Question 46

Who may open explosive boxes?

Answer **[MHTA Regulation 4.2(1)(b)(i)(b)]**

A person authorized by the employer.

Question 47

To what extent may a miner be assisted by uncertificated persons?

Answer **[MHTA Regulations 4.4(3)]**

The miner may be assisted by a person appointed in terms of MHTA regulation 4.4(3) with the following activities:

- a) Exercising control over *explosives*;
- b) The preparation of *primers*;
- c) The charging of *shot holes* with or the placing of *explosive* charges;
- d) The connecting of *blasting* rounds or circuits; and
- e) The handling and transport of explosives, initiation systems and accessories.

Question 48

What characteristics should a shot exploder have?

Answer **[Code of Practice]**

- a) A removable operating handle, key or some locking arrangement to secure it against unauthorized use and it must be marked with a serial number.
- b) It must be maintained in efficient and safe working order and a record shall be kept of all examinations and tests carried out on it.

Question 49

Where more than one miner is charging holes simultaneously in a quarry what precautions must be taken?

Answer **[Code of Practice]**

They must not charge holes within six meters of one another and the explosives receptacles of one miner may not be nearer than six meters to the explosives receptacles of the other miner.

Question 50

How must blasting be conducted near buildings, public thoroughfares, railways, power lines or any place where people congregate?

Answer **[MHTA Regulations 4.16(2)]**

No blasting operations are carried out within a horizontal distance of 500 meters of any public building, public thoroughfare, railway line, power line, any place where people congregate or any other structure, which it may be necessary to protect in order to prevent any significant risk, unless:

- a) A risk assessment has identified a lesser safe distance and any restrictions and conditions to be complied with;
- b) A copy of the risk assessment, restrictions and conditions contemplated, in paragraph (a) have been provided for approval to the Principal Inspector of Mines;
- c) Written permission has been granted by the Principal Inspector of Mines; and
- d) Any restrictions and conditions determined by the Principal Inspector of Mines are complied with.

Question 51

Who may mark holes in an opencast mine?

Answer **[MHTA Regulations 4.4(1)(e)]**

The Miner may mark or indicate *shot holes* for drilling or to authorize the drilling of *shot holes* marked or indicated by another person authorized to do so by the *Employer*, except where the *shot holes* were marked or indicated

by means of electronic software system, including but not limited to Global Positioning System or Laser, the *competent person* must be required to over inspect and authorize the commencement of drilling of *shot holes*.

Question 52

Where must drinking be provided at an opencast mine?

Answer [MHTA Regulations 9.2(4)]

At points reasonably accessible to working places.

Question 53

Who may conduct blasting operations in an opencast mine?

Answer [MHTA Regulation 4.4(1)]

The holder of a blasting certificate, permanent or provisional, valid for opencast mines.

Question 54

Who must be appointed to search persons for explosives in the workings of a mine?

Answer [Code of Practice and MHTA Regulations 4.1(1)]

The *employer* must take *reasonably practicable* measures to prevent persons not authorized by the *employer* from:

- a) Gaining access to *explosives*;
- b) Being in possession of *explosives*, or
- c) Removing or attempting to remove *explosives* from a *mine*.

Question 55

State what is regarded as "clothes" for risk work.

Answer [MHTA Section 6(2) and MA regulation 5.8.3]

- a) Every employer must ensure that sufficient quantities of all necessary personal protective equipment are available so that every employee who is required to use that equipment is able to do so.
- b) No person must work or be present at, or near or cause or permit any other person to work or be present at or near any place where there may be danger of falling minerals or material unless he/she or such other person wears a hard hat in good condition and of a type approved by the Chief Inspector of Mines.

Question 56

Who has the right to cancel a blasting certificate if it's being fraudulently/improperly used?

Answer [MHTA Regulation 29.1.2]

The Chief Inspector of Mines have a right to cancel and retain a blasting certificate if in his/her opinion, such certificate is being fraudulently or improperly used?

6.2 SURFACE MINE PRACTICES AND PROCEDURES

Question 1

What is the miners duty regarding the safety of all persons when encountering dangerous ground?

Answer**[Code of Practice]**

Before installing any support system under dangerous ground, or allowing dangerous ground or rock to be drilled into with the object of rock-bolting it or blasting it down, the ganger or miner in charge shall, by setting props or otherwise, adequately safeguard any person engaged in such operations.

Question 2

Describe the following terminology:

- a) Slip
- b) Fault
- c) Dyke

Answer

- a) *Slip* - A joint or pronounced cleavage plane
- b) *Fault* - A fault or fracture zone along which there has been displacement of the two sides relative to one another parallel to the fracture
- c) *Dyke* - Where molten rock has moved into a crack in the strata and then cooled down, forming solid rock in the strata

Question 3

Which is the more dangerous side of a slip?

Answer

The weaker side of the slip incorporating the area between the high wall and the fault/slip plane. This would often be the down dip side.

Question 4

Name any two methods of stabilizing highwalls which are deteriorating

Answer**[Code of Practice]**

- a) Wire mesh
- b) Roof bolts
- c) Shotcrete

Question 5

Why is it essential to have stable benches and high walls?

Answer

To ensure the safety and health of workmen and for the security and protection of equipment, access roads and production areas.

Question 6

Name several factors which can affect high wall or bench stability?

Answer

- a) Mine design
- b) Rock type
- c) Geological factors
- d) Drilling standards
- e) Blasting standards
- f) Improper drilling or blast selection criteria

Question 7

When should a bench or high wall be inspected?

Answer

At the beginning of each shift, after each blast and after any discernible movement.

Question 8

Where should this inspection take place?

Answer

Inspection should take place at safe points to the side of, at the top of and below the bench or high wall. Any anomaly (deviation) must be noted and reported and immediate action taken to safeguard persons and equipment.

Question 9

May you undercut an open face?

Answer**[MA Regulation 7.9.1(a)]**

No. The face or side wall of any portion of an open cast mine, or any portion of a dump, dam or heap of sand, soil, gravel, clay, tailings, slimes, ash, debris or similar ground or deposit may not be undercut unless permitted by the Principal Inspector and under such conditions as he may prescribe.

Question 10

How does accurate drilling and the correct use of explosives together with correct sequencing of blasting help to ensure the maintenance and integrity of highwalls and benches.

Answer

The combination above should ensure that the explosive energy is directed towards breaking the intended rock with minimum backbreak and disturbance to the next blast and highwall.

Question 11

How must a quarry face be worked?

Answer**[MA Regulation 7.9.2]**

No undercutting is permitted. The faces may be sloped or terraced back at a safe angle. Vertically drilled faces tend to lie back at a 'batter' angle of up to 20° from the vertical. The edge of every face must be cleared of all debris, loose material and stones to a distance of at least 3m.

Question 12

Name three blasting techniques that can be used to enhance the stability of high walls of benches.

Answer

Any of the following:

- a) Pre-splitting
- b) Smooth (cushion) blasting
- c) Post-split (trim) blasting
- d) Line drilling
- e) Longer delays on back holes
- f) Reduced burdens on back holes
- g) Increased stemming depths on back holes

Question 13

Which factors should be considered to achieve satisfactory high wall stability?

Answer

- a) Drilling accuracy and parallelism
- b) Angle of perimeter holes

- c) Sub-drilling
- d) Explosives coupling ratio
- e) Explosives type
- f) Stemming of holes
- g) Guide holes
- h) Geological factors
- i) Charging of perimeter easer holes

6.3 SURFACE MINE MACHINERY

Question 1

What do the regulations require where two or more belt conveyors are in series?

Answer

[MHSR Regulation 8.9(1)(h)]

In compliance with regulation 8.8(1) the employer must ensure that where two or more conveyor belt installation are used in series sequence interlocking is provided which will automatically will stop, except when approved maintenance specific procedures are carried out that require an independent conveyor test run;

- a) stop all other conveyor belt installations feeding a conveyor belt installation that has stopped, and
- b) prevent a conveyor belt installation from starting until the conveyor belt installation on to which it feeds is running

Question 2

Name the main components of the belt conveyor systems and feeder.

Answer

1	<p>The following are components of the drive unit:</p> <ul style="list-style-type: none"> a) Electric motor b) Fluid coupling c) Reduction gearbox d) Driving drum e) Snub pulley
2	<p>The following are components of the belt structure:</p> <ul style="list-style-type: none"> a) Structure trestles b) Return idlers c) Troughing idler frames and idlers d) Belt
3	<p>The following are components of the tail pulley unit:</p> <ul style="list-style-type: none"> a) Return pulley b) Impact idlers c) Structure frame d) Spillage plates e) Guards
4	<p>The following are components of the feeder:</p> <ul style="list-style-type: none"> a) Electric motor and switchgear b) Reduction gear box c) Flight chain d) Tipping bin

Question 3

What substances may cause a fire hazard on and around electrical switchgear and motors, and what preventative steps must be taken?

Answer**[MHSR Regulations 3.7]**

The employer must take reasonably practicable measures to ensure that all suspended electrical cables that could cause a fire due to faults or mechanical damage, in stopes, haulages or shaft either through damage by moving machinery or by fall of ground are properly protected by:

- a) A switch gear which is electrically supplied and commissioned with discrimination settings for overload and earth fault protection to prevent a fire.
- b) Switchgear installed which is correctly rated to prevent a fire or explosion
- c) All cables in areas where a fire can occur must be fire retardant cables or be coated with fire retardant material at areas in close proximity with timber.
- d) The employer must have a procedure to be followed in the event of such a fire.

Question 4

State the causes and solutions for the following problems that may be encountered on a conveyor belt installation:

- a) One section of belt runs off to one side all along the conveyor
- b) Excessive wear on bottom side of belt
- c) Return belt has no definite running pattern (wanders from side to side at will).

Answer

- a) One section of belting runs off to one side all along the conveyor

CAUSE	SOLUTION
<ol style="list-style-type: none"> i. Splices not square ii. Crooked or "bowed" belt 	<ol style="list-style-type: none"> i. Re-splice, cutting ends square ii. If bow is in new belt it will correct itself when belt becomes 'broken in', otherwise replace with new section

- b) Excessive wear on bottom side of belt

CAUSE	SOLUTION
<ol style="list-style-type: none"> i. Slippage between belt and drive pulley, or pulleys ii. Sticking troughing idlers iii. Material grinding between pulley and belt 	<ol style="list-style-type: none"> i. Increase tension on belt take-up device. Lag drive pulleys or renew worn-out lagging ii. Increase arc of contact on drive pulley with snub pulley, or use tandem drive iii. Replace, or free iv. Install scrapers in front of tail pulley on the return belt

- c) Return belt has no definite running pattern (wanders from side to side at will)

CAUSE	SOLUTION
<ol style="list-style-type: none"> i. Insufficient friction between belt and rolls 	<ol style="list-style-type: none"> i. Check idler spacing (bearing load carrying capacities in mind). ii. Open idlers spacing by removing alternate return idlers, or by repositioning idlers

Question 5

How may hazards relating from stray electrical currents be greatly reduced?

Answer**[Code of Practice]**

- a) Connecting all electrical equipment to low resistance earths (not more than 1ohm).
- b) Electrically bonding all rails, pipelines, armoured cables, etc., together at frequent intervals.
- c) Keeping power cable insulation and insulators in good repair.

- d) Keeping the firing lines and the detonator circuits completely insulated from earth, other conductors and other possible sources of stray currents.
- e) Leaving all detonator wires shorted and insulated until connections are to be made.

Question 6

What precautions must be taken before welding, flame cutting or flame-heating takes place?

Answer **[Code of Practice]**

Adequate means for extinguishing any fire which may result must be immediately available.

Question 7

What does the law state with regards to exposed machinery when in motion?

Answer **[MA Regulations 20.5]**

All exposed machinery which, when in motion, may be dangerous to any person shall be securely fenced off. Efficient guards must be provided to such parts of any machinery as maybe a source of danger to any person.

Question 8

What precautions are required where conveyor installation are used in a confined space?

Answer **[MHSa Section 9(2)]**

The employer must implement a Code of Practice on the safe use of conveyor belt installation for the transportation of mineral, material and personnel.

Question 9

What are the requirements regarding the installation of electrical apparatus which may constitute a danger to persons?

Answer **[MHSa Regulations 3.2 and 3.3]**

- a) The employer must take reasonable practicable measures to ensure that no person suffers any electrical shock, arc flash or electrocution as a result of:
 - i. Exposure to electrical current flow
 - ii. A person coming into contact with live exposed parts of any electrical apparatus
 - iii. Exposure to electricity, arc flash, all fault current, overvoltage and surges
 - iv. Any electrical apparatus failing due to electromagnetic interference from other equipment
 - v. Any electrical apparatus being incorrectly designed, installed, operated or maintained
 - vi. Any exposure to blasts, fires or arc flashes resulting from faults
- b) The measures indicated above must include measures to ensure the following:
 - i. Proper fencing off or enclosures or clearances of such electrical apparatus
 - ii. That an extension of any electrical reticulation system is approved by a competent person before being energized, taking into account the reticulation network and the effect thereon
 - iii. That only competent persons are permitted to energize, de-energize or isolate electrical apparatus where the operation of such apparatus poses a significant risk and that such apparatus are protected against unauthorized access and operation
 - iv. That only competent persons authorized in writing by the employer to do so, carry out switching procedures on MV or HV equipment
 - v. That where there is interruption of electrical supply to any equipment could result in a significant risk, such electrical supply can be provided from another source or network which can include an emergency supply alternator or generator for power supply in the event of an interruption to the normal power supply

Question 10

How does the appointed person ensure that all mobile machinery is kept in good running order?

Answer**[MHTA Section 9(2), TMM Code of Practice]**

The appointed engineer or competent person must satisfy himself by a daily written report by a competent person appointed by him in writing that the signaling devices and all safety devices in his area of responsibility have been examined by him and are in a safe working condition.

Question 11

What precautionary measures are to be taken before any person enters any place with an accumulation of water?

Answer**[MA Regulations 5.8.2]**

No person must enter, or cause or permit any other person to enter any accumulation of water or mud other than an accumulation known to be insignificant unless such person is secured by a life line or otherwise suitably safe guarded.

6.4 INTRODUCTION TO EXPLOSIVES**Question 1**

What is the purpose of the clip on the shock tube assembly?

Answer

To ensure that the shock tube is connected at right angles to the detonating cord

Question 2

Explain the basic difference between electric and non-electric initiation.

Answer

- a) *Electric initiation* uses an electric power source with associated circuit and wiring to convey electrical energy to the detonator.
- b) *Non-electric initiation* uses various types of chemical reactions ranging from deflagration to detonation as a means of conveying the impulse to non-electric detonators.

Question 3

What does the strength of detonators refer to?

Answer

It refers to the mass of PETN used in the base of the detonator determines the strength of the detonator. No. 6 detonator typically contains 0.35 grams PETN and No. 8 detonator 0.78 grams.

Question 4

Name four essential components of an electric detonator.

Answer

Any of the following:

- a) The detonator tube
- b) The base charge
- c) The initiating compound
- d) The delay element
- e) The fusehead
- f) The lead wires
- g) The closure plug

Question 5

What is the burning speed of detonating cord?

Answer

6000-7000 metres per second

Question 6

Name the two distinct modes of propagation and briefly explain the difference between the two.

Answer

- a) *Detonation* propagation reaction very rapid, creates stable shock wave.
- b) *Deflagration* propagation reaction related to burning, no shock wave created.

Question 7

Name four types of energy that is wasted during an explosion.

Answer

- a) Heat energy
- b) Light energy
- c) Sound energy
- d) Seismic energy

Question 8

What is important to remember about cost, when selecting an explosive?

Answer

The price per kilogram or even price per unit of energy is only the starting point in determining the most cost-effective explosive for a specific operation. What needs to be considered is the full cost of producing a fully broken rock mass and processing that rock mass in further beneficiation.

Question 9

What safety risk does watergel cartridge have with regards to water resistance?

Answer

Even after considerable damage to the packaging, watergel will detonate with high energy after several weeks underwater in a blasthole.

Question 10

What are the most important factors that need to be considered when any blasting technique is used?

Answer

- a) Angle of perimeter holes
- b) Explosives coupling ratio
- c) Geological factors

Question 11

What other factors may be considered when any blasting technique is used?

Answer

- a) Drilling accuracy and parallelism
- b) Sub-drilling
- c) Explosives type
- d) Stemming of holes
- e) Guide holes
- f) Charging of perimeter easer holes
- g) Scale of operations
- h) Timing of blast

Question 12

Is the following statement true or false? Motivate your answer.

The upper half of the bench face is more prone to backbreak than the lower half, and it is therefore good practice to use a reduced charge mass in the top area to obtain a lower coupling ratio.

Answer

True – This can be done as follows:

- a) Bulk explosives – holes can be sleeved or decked
- b) Cartridged explosives – spacing can be increased

Question 13

Complete the following sentence:

In many circumstances, the _____ energy from explosives can significantly reduce the _____ of the rock behind and to the sides of the blasted volume.

Answer

In many circumstances, the *confined gas* energy from explosives can significantly reduce the *structural strength* of the rock behind and to the sides of the blasted volume.

Question 14

Is the following statement true or false? Motivate your answer.

Trailing cables are probably the greatest source of stray currents.

Answer

True – Faulty or damaged insulation of these cables is a likely source of stray currents

6.5 TRANSPORT, STORAGE AND SECURITY OF EXPLOSIVES

Question 1

What materials, implements or tools may be placed in an explosive box/drum?

Answer

[MHTSA Regulations 4.2(1)(b)(iii)]

No person must place, or cause or permit any other person to, place any other materials or any implements or tools, in the *explosives* containers other than those necessary for the preparation of initiation systems or primers.

Question 2

When loading or unloading explosives from a vehicle how far must you be from a fire, naked light or flame?

Answer

[MHTSA Regulation 4.16(3)]

Not less than 10 meters and nobody may smoke within this distance.

Question 3

Where must the explosives initiating devices be stored.

Answer

Explosives initiating devices must be stored in a manner prescribed by the employer.

6.6 BASIC BLASTING DESIGNS

Question 1

Why is it more expensive to drill in hard rock than soft rock?

Answer

Because of the slower penetration rate in hard rock, it would take longer to drill the same holes into hard rock than into soft rock. Longer time means more man hours and wear on equipment.

Question 2

Why is sub-drilling done?

Answer

Sub-drill is practiced to maintain an even floor by ensuring breaking to the desired elevation. However, use of an air gap at the bottom of the hole can reduce the need for sub-drill and assist in creating a horizontal split.

Question 3

Name three advantages of using larger (fewer) blasts.

Answer

- a) Less time, supervision
- b) Fewer hazards associated with blast preparations
- c) Less environmental and community disturbances

Question 4

Is the following statement true or false? Motivate your answer

When vibration is accompanied by considerable noise, it is more alarming to people.

Answer

True – This is because impulsive sound draws more attention to the unfamiliar occurrence.

Question 5

What is air-blast?

Answer

Air-blast means vibration through the air manifests as either audible noise or inaudible concussion, and is measured in terms of overpressure exerted on the surroundings.

Question 6

Name three components that are required for a typical air-blast monitoring system.

Answer

- a) Mounted detector
- b) Detector system with microphone and amplifiers
- c) Wind screen covers on microphone (required to reduce noise due to wind)
- d) Data recorder and analyzer

Question 7

How does stemming column length influence flyrock?

Answer

- a) If the stemming column is too long, oversize collar rock will occur.
- b) If the stemming column is too short, excessive flyrock will result.

Question 8

Name six factors that should be considered when using pre-splitting.

Answer

- a) Existence of prominent slips and joints

- b) Blasting vibrations
- c) Transmission of blasting vibrations
- d) Possibility of block movement
- e) Curves and corners
- f) Rock quality – prone to splitting

Question 9

What kind of explosives would you use in?

- a) Wet holes
- b) Dry holes

Answer

[Code of Practice]

- a) Wet holes – emulsion/watergel or ANFO with plastic sleeves
- b) Dry holes – ANFO

Question 10

What steps would you take to make sure that you will not get any misfires if detonating cord is used as trunk lines?

Answer

[Code of Practice]

- a) Check for bridging by detonating cord at the dog-bone-relays
- b) Make sure that the trunk lines and down lines do not touch
- c) Make sure that the trunk lines do not intertwine

6.7 BLASTING PROCEDURES

Question 1

How often must explosives recovered be destroyed?

Answer

[Code of Practice]

At least once every four days.

Question 2

Where more than one miner is charging holes simultaneously in an opencast mine what precautions must be taken?

Answer

[Code of Practice]

They must not charge holes within six meters of one another and the explosives receptacles of one miner may not be nearer than six meters to the explosives receptacles of the other miner.

Question 3

Why must a drilled hole be measured before charging up?

Answer

To determine if it is drilled to the correct drill depth and to calculate the quantity of explosives required.

Question 4

What is the advantage of charging a shot hole with a constant amount of explosives?

Answer

Explosive usage is easy to calculate

Question 5

What are the disadvantages of charging a shot hole with a constant amount of explosives?

Answer

- a) Shorter holes can be overcharged with explosives and cause flyrock
- b) Deeper holes can cause poor fragmentation in the increased stemming area

Question 6

What is the advantage of tamping a short-hole with a constant stemming height?

Answer

Oversized rocks from the stemming area can easily be monitored and ultimately the stemming column can be increased or decreased to meet the required end result.

Question 7

What are the disadvantages of tamping a short-hole with a constant stemming height?

Answer

- a) Explosive consumption difficult to pre-estimate.
- b) Cost of explosive usage goes up when holes are drilled deeper than required and are not back filled.

Question 8

Why is accurate drilling necessary?

Answer

Inaccurate drilling (drilling errors) causes variations in the burdens and spacing resulting in inconsistent breaking of the rock.

Question 9

Is any person allowed to bury explosives?

Answer

[MHTA Regulations 4.1(3)]

No person may, or cause or permit any other person to, bury, hide, submerge or abandon any explosives.

Question 10

Why don't normal fire extinguishing techniques work with Ammonium Nitrate fires?

Answer

These methods deprive the fire of oxygen and in doing so smothers it. Ammonium Nitrate itself supplies sufficient oxygen for the combustion and therefore normal techniques are ineffective. Ammonium Nitrate fires should be extinguished with water.

Question 11

How and when should misfires be reported?

Answer

[Code of Practice]

If a misfire is not dealt with at the end of a working shift, it should be reported to the Miner and supervisor of the next shift.

6.8 PRACTICAL BLAST LAYOUTS

6.8.1 OPEN PIT MINING

Question 1

A block of medium strength overburden has been cleared over an area of 360m long and 50m deep at a rural coal strip mine. The blast holes are drilled using a rotary drill rig averaging 38m/hr on 2 x 10 hour worked shifts producing 250mm diameter holes on an average bench height of 20m. As much of the area as possible has to be blasted.

Assume: Burden = 30 x hole diameter
 Spacing = 1.2 x burden
 Stemming Depth = 20 x hole diameter
 Sub-drill = 4 x hole diameter
 Explosives: Heavy ANFO; 1 g/cc \equiv 50 kg/metre

Calculate the following:

- Burden and spacing
- Volume of overburden to be blasted
- Total weight of explosives to be ordered
- Powder factor
- Days to complete drilling assuming no interruptions

Evaluation of results:

- The manager comments that the drilling and blasting costs are too high – what could be done to improve blasting efficiencies without adversely affecting production and safety or health.

Answer

- $B = 30 \times 250 \text{ mm} = 7.5 \text{ m}$
 $S = 1.2 \times B = 1.2 \times 7.5 = 9 \text{ m}$
- Block depth $50 \text{ m} \div 7.5 = 6.67 \therefore 6$ rows
Block length $360 \div 9 = 40 \therefore 40$ spaces
Total area of blast = $(6 \times 7.5)(40 \times 9) = 45 \times 360 \text{ m} = 16200 \text{ m}^2$
Total volume of blast = $16200 \times 20 = 324000 \text{ m}^3$
- Stemming = $20 \times 250 \text{ mm} = 5 \text{ m}$
Sub-drill = $4 \times 250 \text{ mm} = 1 \text{ m}$
Total number of holes = $6 \times 40 = 240$ holes
Charged depth = $20 + \text{sub-drill} - \text{Stemming}$
 $= 20 + 1 - 5 = 16 \text{ m}$
Charge per hole = $16 \times 50 \text{ kg} = 800 \text{ kg}$
Total explosives needed = $240 \times 800 = 192000 \text{ kg} = 192 \text{ tons}$
- Powder factor
Kg of explosives \div m^3 blasted
 $192000 \div 324000 = 0.593$
- Drilling time
Drilling length = $20 + 1 = 21 \text{ m} \times 240 = 5040 \text{ m}$
Rate per day = $20 \times 38 = 760 \text{ m/day}$
 $5040 \div 760 = 6.63$ say 7 working days

- f) Powder factor is too high for class of rock being blasted – could be 0.3 → 0.5 kg/m³
- i) Can increase burden and spacing, say to 9 m x 12 m
- ii) Can increase stemming depth, say to 6 m

Revised calculations:

Block depth $50 \div 9 = 5.56 \therefore 5$ rows

Block length $360 \div 12 = 30 \therefore 30$ spaces

Vol of blast = $(5 \times 9)(30 \times 12) \times 20 = 324000 \text{ m}^3$

No of holes = $5 \times 30 = 150$ holes

Total explosives = $(20 + 1 - 6) \times 50 \times 150 = 112.50$ tons

Powder factor = $125000 \div 324000 = 0.386 \text{ kg/m}^3$

Drilling time = $(21 \times 150) \div 760 = 4.14$ say 5 days

42% saving on explosives

37.5% saving on drilling

Question 2

An opencast coal mine exposes a dolerite sill 40m long, 20m wide and 9m deep. A DTH drill rig drills 115mm diam holes on a 4 x 5m pattern to the bottom of the sill. The blaster decides to use explosives with a density of 1.15 g/cc and a powder factor of 0.5.

Assuming a column rise (kg of explosives per m of hole) of 11.8:

- a) How much explosive should be ordered?
- b) What would the average stemming depths be?
- c) What possible hazards could occur?

Answer

- a)
- | | | |
|---------------------|---|--|
| Hole vol | = | $4 \times 5 \times 9 = 180\text{m}^3$ |
| Powder Factor | = | 0.5 |
| Expl per hole | = | $20 \times 40 = 800\text{m}^2$ |
| Area per hole | = | $4 \times 5 = 20\text{m}^2$ Total holes = $800 \div 20 = 40$ holes |
| Total Expl required | = | $40 \times 90 = 3600\text{kg}$ |
- b)
- | | | |
|----------------------|---|-------------------------------|
| Expl weight per hole | = | 90kg |
| Charge length | = | $90 \div 11.8 = 7.63\text{m}$ |
| Av uncharged length | = | $9 - 7.63 = 1.37\text{m}$ |
- c)
- | | | |
|-------------------------------|---|---------------------------------------|
| Rule of Thumb stemming height | = | $0.7 - 1.3 \times \text{burden (4m)}$ |
| | = | $2.8 - 5.2\text{m}$ |
- \therefore Risk of fly rock and high sound over pressure

Question 3

A coal mine wishes to blast 150,000 T of overburden on a 20m bench using a rotary drill with 311mm dia bits. The rock density is +/- 3.0 T/m³ and explosive density is 1.00 g/cc (76kg/m of hole).

Using rule of thumb methods:

- | | | |
|------------|---|---|
| B (Burden) | = | $\frac{\sqrt{\text{Constant (0.9)} \times \text{Bench Height (m)} \times \text{Drill diam (mm)}}}{100}$ |
| S (Spec) | = | $B \times 1.25$ |
| Sub-drill | = | $0.2 \times \text{Burden}$ |
| Stemming | = | $B \times 1.25$ |

Calculate the following:

- Volume broken per hole
- The number of holes required
- Explosive charge per hole
- Powder factor
- Total explosives required

Answer

a) Burden = $\frac{\sqrt{0.9 \times 20 \times 311}}{100} = 7.5\text{m}$
 Spacing = $7.5 \times 1.25 = 9.4\text{m}$
 Volume per hole = $7.5 \times 9.4 \times 20 = 1410\text{m}^3$
 Tonnes per hole = $1410 \times 3 = 4230 \text{ tonnes}$

b) Number of holes = $250,000 \div 4230 = 59.1$ Say 60 holes

c) Explosives charge per hole:
 Length of explosive column = $20 + (7.5 \times 0.2) - (7.5 \times 1.25)$
 = $20 + 1.5 - 9.4$
 = 12.1m
 Explosives per hole = $12.1\text{m} \times 76 = 920\text{kg}$

d) Powder factor
 $920\text{kg per hole} \div 1410\text{m}^3 \text{ per hole} = 0.65\text{kg/m}^3$

Question 4

A blast has to be designed for 50,000 T of coal from a 9m thick seam and coal density of 1.5 T/m³. The 3 drills average 30m/hour each including move/set up with 64mm bits. Explosive available has a density of 1 g/cc equivalent to 3.2kg/m of hole.

Assuming:

$$B = \frac{\sqrt{0.9 \times \text{Hole dia (mm)} \times \text{Face Height (m)}}}{100}$$

$$S = B \times 1.25 \quad \text{STEM} = B$$

Calculate:

- Number of holes required
- Time taken to drill blast
- Total explosives required
- Powder factor

Answer

a) B = $\frac{\sqrt{0.9 \times 64 \times 9}}{100}$
 = $\frac{\sqrt{5.184}}{100} = 2.27 = 2.3\text{m}$
 S = $2.3 \times 1.25 = 2.875 = 2.9\text{m}$

Volume per hole = $2.3 \times 2.9 \times 9\text{m} = 60\text{m}^3/\text{hole}$
 Tons per hole = $60 \times 1.5 = 90 \text{ tons/hole}$
 Holes required = $50,000 \div 90 = 555 \text{ holes}$

b) Total drill length = $555 \times 9 = 4995\text{m}$
Average metres per drill = $4995 \div 3 = 1665\text{m}$
Time per drill = $1665 \div 30 = 55.5 \text{ hours}$
Assuming 7 hours drilling per shift time taken $\equiv 8 \text{ shifts}$

c) Charge length per hole = $9 - 2.3 = 6.7\text{m}$
Explosives charge/hole = $6.7 \times 3.2 = 21.44\text{kg/hole}$
Total explosives = $555 \times 21.44 = 11,899.2\text{kg}$

d) Vol of coal blasted = $55 \times 2.3 \times 2.9 \times 9 = 33,316.65\text{m}^3 (\equiv 49,975 \text{ T})$
P.F. = $11,899 \div 33,317 = 0.357$

6.8.2 QUARRY MINING

Question 1

At an urban quarry, a drill and blast contractor has to produce +/-20,000 tonnes of blasted dolerite rock (3.10 T/m^3) which will be fed to a 30 x 42 jaw crusher. The bench height is 15m and they use a hydraulic drill rig with 76mm drill bits. To obtain the required fragmentation, history has indicated that a powder factor of 0.70 or greater is required.

Assume an explosive density of 1.2 g/cc (5.44 kg/meter).

Calculate the following:

- No. of holes required
- Total explosives required
- A building is 500m from the blast. If the maximum mass charge per delay is 250kg, what is the greatest number of shot holes which can be detonated at the same time?

Answer

a) Rules of Thumb

B	=	$25 - 25 \times \text{Hole Diameter}$	Say	30
S	=	$1 - 1.5 \times B$	Say	1.3
Sub-Drill	=	$0.2 - 0.5 \times B$	Say	0.4
Stem	=	$0.7 - 1.3 \times B$	Say	0.8

B = $30 \times 76 = 2.3\text{m}$
S = $2.3 \times 2.3 = 2.99 = 3.0\text{m}$
Volume to be blasted = $20,000 \div 3.10 = 6349\text{m}^3$
Area to be blasted = $6349 \div 15 = 423\text{m}^2$
Area per hole = $2.3 \times 3.0 = 6.9\text{m}^2$
Holes needed = $423 \div 6.9 = 62.3 \text{ say } 63 \text{ holes}$

b) Explosives required

Charge Length = $15 + (0.4 \times 2.3) - (0.8 \times 2.3)$
= $15 + 0.9 - 1.8$
= 14.1m

Charge per hole = $14.1 \times 5.44 = 76.7\text{kg/hole}$
Total explosives = $63 \times 76.7 = 4832\text{kg}$

Check powder factor:
New Volume = $63 \times 6.9 \times 15 = 6520.5\text{m}^3$
P.F. = $4832 \div 6520.5 = 0.74$

c) Charge per hole = 76.7kg
Max mass charge per delay = 250kg
 $250 \div 76.7 = 3.2$
 \therefore Max holes on same delay = 3

6.9 DUST PREVENTION

Question 1

Where a mineral is crushed, screened, moved, handled etc. how must dust be controlled?

Answer

By water, other dust allaying agent or by a dust extraction system.

Question 2

If the water supply fails what must you do?

Answer

Stop all dust producing operations until the supply is restored.