MINING LEARNING SERIES

Mining Exam Challenge: Mixed Test Prep

A 100-mark practice test with calculations, case studies and a complete memorandum

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CHALLENGE TARGET

Total: 100 marks | Suggested time: 120 minutes. Attempt the test without the memorandum, show every calculation step, then use the marking guide to identify the exact topics you must revise.

Exam Instructions and Strategy

Section	Topic	Marks
A	Multiple choice	10
B	Terminology and concepts	10
C	Geology and exploration	12
D	Safety, health and risk	12
E	Machines and calculations	16
F	Processing and metallurgy	12
G	Environment and communities	10
H	Future mining and economics	10
I	Integrated case study	8
TOTAL		100

Instructions

- Answer every question.
- For multiple choice, write only the question number and letter.
- Show the formula, substitution, unit and final answer for calculations.
- Use mining examples where requested.
- Read command words carefully: define, distinguish, explain, calculate, evaluate and recommend.
- Do not open the memorandum until you have completed the test.

Formula box

Quantity	Formula
Availability / utilisation	available / scheduled x 100%; operating / available x 100%
Production / stockpile	cycles x payload; volume x bulk density
Recovery / grade	valuable in concentrate / valuable in feed x 100%; valuable / total x 100%
Risk / percentage change	likelihood x consequence; (new - old) / old x 100%

TIME PLAN

Use about 1.2 minutes per mark. First collect easy marks, then return to longer calculations and case-study explanations.

Section A: Multiple Choice

Choose the best answer. Each question carries 1 mark. [10]

1. Which rock forms when magma cools and solidifies?

A Sedimentary B Igneous C Metamorphic D Weathered

2. Which method best measures variation in the Earth's magnetic field?

A Trenching B Magnetic survey C Flotation D Ventilation survey

3. The strongest level in the hierarchy of controls is:

A PPE B Administrative control C Elimination D Warning sign

4. A loader is available for 9 h and operates for 7.2 h. Utilisation is:

A 72% B 75% C 80% D 125%

5. The main purpose of crushing is to:

A Increase particle size B Liberate minerals progressively C Add water D Refine metal

6. Froth flotation mainly separates particles using differences in:

A Surface properties B Colour only C Radioactivity only D Melting point

7. A closure plan should begin:

A After production ends B During final month C Early in mine planning D Only after a complaint

8. Teleoperation means:

A A machine controls all laws B A person controls equipment from a distance C No operator exists D Paper records are digitised

9. Mining GDP measures mainly:

A Total mine sales B Value added C Export tonnes only D Company cash balance

10. A mineral royalty is linked to:

A Transfer of extracted mineral resources B Employee overtime C Rainfall D School marks

SECTION A TOTAL

10 marks. Check that every answer uses one letter only.

Section B: Terminology and Concepts

Answer all questions. [10]

Question 11: Match the columns [5]

Column A	Column B
11.1 Ore	A. Waste rock surrounding or mixed with valuable material
11.2 Gangue	B. Data-connected model of a physical asset or process
11.3 Rehabilitation	C. Rock containing material that can be mined economically
11.4 Digital twin	D. Returning disturbed land to a stable, useful condition
11.5 Beneficiation	E. Adding value through processing or manufacturing

Question 12: Short definitions [5]

12.1 Define mineral resource. [1]

12.2 Define hazard. [1]

12.3 Define cut-off grade. [1]

12.4 Define photogrammetry. [1]

12.5 Define indirect economic effect. [1]

COMMAND-WORD REMINDER

A definition earns the mark by stating the essential meaning. Do not replace a definition with only an example.

Section C: Geology and Mineral Exploration

Answer Questions 13-15. [12]



Figure 1: Drill core provides direct evidence of rock type, structures, alteration and mineralisation. | Source: Business News Australia

Question 13: Visual interpretation [4]

13.1 Identify the exploration activity shown in Figure 1. [1]

13.2 State two observations that should be recorded from the core. [2]

13.3 Explain why core recovery must be recorded. [1]

Question 14: Exploration sequence [4]

Arrange these from early to later work: resource modelling; regional research; drilling; detailed geophysics/geochemistry. Then explain why exploration becomes more expensive as confidence increases. [4]

Question 15: Grade calculation [4]

A 2.5 kg sample contains 37.5 g of copper. Calculate the copper grade as a percentage. Show conversion and working. [3]

State one reason why a single sample should not be used to declare an orebody. [1]

CALCULATION HINT

Convert both masses to the same unit before using grade = valuable material / total sample x 100%.

Section D: Mining Safety, Health and Risk

Answer Questions 16-18. [12]

Question 16: Risk assessment [5]

A workshop floor is oily beside a frequently used walkway. The team rates likelihood = 4 and consequence = 3 on a 1-5 scale.

16.1 Calculate the risk rating. [1]

16.2 Identify the hazard and one possible unwanted event. [2]

16.3 Recommend one elimination/engineering control and one administrative control. [2]

Question 17: Hierarchy of controls [3]

Explain why PPE is normally weaker than eliminating or engineering out a hazard. Give one mining example. [3]

Question 18: Occupational health [4]

18.1 Name two long-latency mining health hazards. [2]

18.2 Explain two actions used to control worker exposure to airborne dust. [2]

Mini risk matrix

Consequence →	1	2	3	4	5
Likelihood 1	1	2	3	4	5
Likelihood 2	2	4	6	8	10
Likelihood 3	3	6	9	12	15
Likelihood 4	4	8	12	16	20
Likelihood 5	5	10	15	20	25

SAFETY PRINCIPLE

A calculated risk score supports judgement; it does not replace legal duties, competent assessment or immediate action when danger is present.

Section E: Machines and Production Calculations

Answer Questions 19-21. Show all working. [16]

Question 19: Availability and utilisation [6]

A drill is scheduled for 10 h. Breakdowns total 1.5 h. During the remaining available time, operating delays total 1.0 h.

19.1 Calculate available hours. [1]

19.2 Calculate availability. [2]

19.3 Calculate operating hours. [1]

19.4 Calculate utilisation based on available hours. [2]

Question 20: Truck production [6]

A haul truck carries 90 t per cycle. Average cycle time is 30 min. It works 7.5 operating hours and achieves a 0.90 payload factor.

20.1 Calculate cycles per hour. [1]

20.2 Calculate theoretical tonnes per operating hour before the payload factor. [1]

20.3 Calculate adjusted shift production. [3]

20.4 State one reason actual production may be lower. [1]

Question 21: Match machine to task [4]

Choose the most suitable machine for each task: production drill; LHD/underground loader; dozer; haul truck. (a) transport broken rock long distance, (b) clean and move broken rock underground, (c) prepare blast holes, (d) push and shape loose surface material. [4]

UNIT CHECK

30 min/cycle = 0.5 h/cycle, so cycles per hour = 1 / 0.5.

Section F: Mineral Processing and Metallurgy

Answer Questions 22-24. [12]



Figure 2: Flotation separates minerals by controlling particle surface behaviour. | Source: A.M. King

Question 22: Process understanding [4]

22.1 Name the process shown in Figure 2. [1]

22.2 Explain the role of a collector and frother. [2]

22.3 State one variable an operator should monitor. [1]

Question 23: Recovery [5]

A plant treats 1,000 t of ore at 2.0% valuable metal. The concentrate contains 18 t of that metal.

23.1 Calculate metal in the feed. [2]

23.2 Calculate recovery. [2]

23.3 State why 100% recovery is rarely achieved in practice. [1]

Question 24: Sequence [3]

Place crushing, grinding and flotation in the correct order, and explain the purpose of progressive size reduction. [3]

MASS BALANCE CHECK

Metal in concentrate cannot exceed metal in feed. If it does, recheck units, grades or data.

Section G: Environment and Communities

Answer Questions 25-27. [10]



Figure 3: Meaningful engagement requires information, listening and a traceable response. | Source: Canyon Coal - Bekezela public meeting

Question 25: Public participation [4]

25.1 Give two features of meaningful community engagement. [2]

25.2 Explain why attendance at one meeting is not enough evidence of consent or effective participation. [2]

Question 26: Rehabilitation [3]

Describe three steps used to rehabilitate a waste-rock or disturbed-land area. [3]

Question 27: Water [3]

A mine detects higher sulphate downstream than upstream. Give one possible mining-related source, one additional check, and one response if the mine is confirmed as the cause. [3]

BALANCED ANSWER

Environmental and community answers should identify the impact, evidence, responsible control and how success will be monitored.

Section H: Future Mining and Economic Impact

Answer Questions 28-30. [10]

Question 28: Automation and AI [4]

28.1 Distinguish teleoperation from autonomy. [2]

28.2 Give one mining use of AI and one reason a human must verify a safety-critical output. [2]

Question 29: Drone stockpile calculation [3]

A drone survey estimates a stockpile volume of 8,400 m3. Verified bulk density is 1.70 t/m3. Calculate estimated tonnes and state one source of uncertainty. [3]

Question 30: Economic impact [3]

Distinguish direct, indirect and induced mining employment effects. [3]

Data box

Indicator	2024 approximate value
Mining GDP	R442.7 billion; about 6% of national GDP
Mineral exports	R774.3 billion
Direct mining employment	474,876 jobs

INTERPRETATION WARNING

GDP, exports, turnover and production are different measures. A large national contribution does not prove that every host community receives an equal benefit.

Section I: Integrated Case Study

Read the scenario and answer Question 31. [8]

SCENARIO: METSI CHROME PROJECT

A proposed surface chrome mine is 12 km from a town. Exploration drilling indicates variable grade. The mine plan uses a drill, excavator and truck fleet. Ore will be crushed and concentrated before transport by road. Residents are concerned about dust, road safety, water use and whether local businesses will benefit. The company proposes drone surveys, collision-warning technology and a rehabilitation trial. Commodity-price forecasts are uncertain.

Question 31 [8]

31.1 Explain why additional drilling may be needed before final mine design. [1]

31.2 Identify one worker hazard and one community hazard. [2]

31.3 Recommend one engineering control for either hazard. [1]

31.4 State one production indicator and one environmental indicator that should be monitored. [2]

31.5 Recommend one action to create durable local economic value. [1]

31.6 Explain one way a commodity-price fall could affect the project. [1]

High-level answer structure

Command	What a strong response does
Identify	Names the specific issue from the scenario
Explain	Gives a cause, link or consequence
Recommend	Proposes a feasible control and links it to the risk
Evaluate	Balances evidence, benefits, limits and trade-offs

TOTAL CHECK

Sections A-I = 100 marks. Move to the answer sheet before opening the memorandum.

Answer Sheet and Self-Review

Multiple-choice grid

Q	Answer	Q	Answer	Q	Answer	Q	Answer	Q	Answer
1		3		5		7		9	
2		4		6		8		10	

Section scorecard

Section	Maximum	My mark	Revision action
A	10		
B	10		
C	12		
D	12		
E	16		
F	12		
G	10		
H	10		
I	8		
TOTAL	100		

Performance guide

USE YOUR SCORE

80-100: correct small gaps. 65-79: redo weak methods. 50-64: revise two sections at a time. Below 50: rebuild the topic foundations, then retest.

Error log

- Knowledge/method error: concept unknown, confused or wrong steps.
- Calculation/reading error: formula, unit, arithmetic, command word or data detail missed.
- Communication error: answer lacked explanation, evidence or mining context.

Memorandum: Sections A-D

Section A [10]

Q	Answer	Reason
1	B	Igneous rock solidifies from magma or lava.
2	B	A magnetic survey measures magnetic-field variation.
3	C	Elimination removes the hazard.
4	C	7.2 / 9 x 100 = 80%.
5	B	Crushing begins progressive liberation.
6	A	Flotation exploits surface-property differences.
7	C	Closure is planned from early project stages.
8	B	A human controls equipment remotely.
9	B	GDP measures value added.
10	A	Royalty is triggered by mineral-resource transfer.

Section B [10]

11.1 C; 11.2 A; 11.3 D; 11.4 B; 11.5 E. [5]

12.1 Concentration/occurrence with reasonable prospects for eventual economic extraction. 12.2 Source or situation with potential to cause harm. 12.3 Lowest grade treated as ore under stated assumptions. 12.4 Measurement/3D reconstruction from overlapping photographs. 12.5 Supplier activity created by mining demand. [5]

Section C [12]

13.1 Core logging/inspection. [1] 13.2 Any two: lithology, mineralisation, alteration, structures, weathering, recovery/RQD. [2] 13.3 Missing core may bias geological and grade interpretation. [1]

14. Regional research -> detailed geophysics/geochemistry -> drilling -> resource modelling. [2] Later work uses denser, direct and technically demanding data to reduce uncertainty. [2]

15. 2.5 kg = 2,500 g. Grade = 37.5/2,500 x 100 = 1.5% Cu. [3] One sample is not spatially representative and cannot establish continuity/tonnage. [1]

Section D [12]

16.1 4 x 3 = 12. [1] 16.2 Hazard: oil on floor; event: slip/fall. [2] 16.3 Examples: remove leak/install drainage or non-slip surface; barricade, clean-up procedure and inspection. [2]

17. PPE depends on correct selection, fit and behaviour and does not remove the hazard; e.g. wet drilling/extraction controls dust before respirators. [3]

18.1 Any two: respirable silica dust, noise, diesel particulate, vibration, heat. [2] 18.2 Examples: water suppression, enclosed cabs, local extraction, ventilation, isolation and exposure monitoring. [2]

Memorandum: Sections E-G

Section E [16]

19.1 Available = 10 - 1.5 = 8.5 h. [1] 19.2 Availability = 8.5/10 x 100 = 85%. [2] 19.3 Operating = 8.5 - 1.0 = 7.5 h. [1] 19.4 Utilisation = 7.5/8.5 x 100 = 88.24%. [2]

20.1 60/30 = 2 cycles/h. [1] 20.2 2 x 90 = 180 t/h. [1] 20.3 180 x 7.5 x 0.90 = 1,215 t/shift. [3] 20.4 Any valid factor: queues, road condition, delays, reduced payload, breakdowns or weather. [1]

21. (a) haul truck; (b) LHD/underground loader; (c) production drill; (d) dozer. [4]

Section F [12]

22.1 Froth flotation. [1] 22.2 Collector makes selected mineral surfaces hydrophobic; frother creates/stabilises suitable bubbles and froth. [2] 22.3 Any valid variable: pH, air rate, level, froth depth, reagent dosage, particle size or density. [1]

23.1 Metal in feed = 1,000 x 0.02 = 20 t. [2] 23.2 Recovery = 18/20 x 100 = 90%. [2] 23.3 Losses occur through imperfect liberation/separation, entrainment, operating limits and mineral variability. [1]

24. Crushing -> grinding -> flotation. [1] Progressive reduction liberates valuable minerals from gangue while controlling energy and suitable flotation size. [2]

Section G [10]

25.1 Any two: timely accessible information; representative participation; two-way dialogue; language/access support; recorded concerns and responses. [2] 25.2 Attendance does not prove understanding, representation, freedom from pressure or that concerns changed the decision. [2]

26. Any three: reshape stable landform; replace growth medium/topsoil; manage drainage/erosion; revegetate with suitable species; monitor and repair. [3]

27. Possible source: seepage/discharge from waste, pit or plant. Check flow, repeat samples, other ions, upstream sources and QA/QC. If confirmed: stop/contain source, treat water and remediate while monitoring. [3]

MARKING RULE

Award equivalent technically correct answers. Calculations require the method and unit; small rounding differences are acceptable.

Memorandum: Sections H-I and References

Section H [10]

28.1 Teleoperation: human controls from a distance; autonomy: machine senses, decides and acts within approved limits. [2]
28.2 Example: predictive maintenance, collision detection or ore classification; human verification is needed because data/model error can create harm and accountability remains human. [2]

29. Tonnes = 8,400 x 1.70 = 14,280 t. [2] Uncertainty: surface model, boundaries, voids, moisture or bulk-density variation. [1]

30. Direct = mine employment; indirect = supplier jobs supported by mining demand; induced = jobs supported by household spending from linked incomes. [3]

Section I [8]

31.1 More drilling improves grade, geometry and continuity confidence for design. [1]

31.2 Worker hazard: mobile-equipment collision/dust/noise; community hazard: truck traffic/dust/water stress. Any valid pair. [2]

31.3 Example: separate pedestrians and vehicles with engineered routes/barriers, or enclosed dust extraction/water suppression. [1]

31.4 Production: tonnes, grade, recovery, cycle time or utilisation. Environmental: dust, water level/quality, noise, erosion or rehabilitation success. [2]

31.5 Example: transparent local supplier development with transferable standards, fair contracts and markets beyond the mine. [1]

31.6 Lower price can reduce revenue, reserves, investment, production, jobs or taxes and may delay the project. [1]

Selected references

DMPR. Mining regulation, exploration and economic context. https://www.dmpr.gov.za/

Mine Health and Safety Council. Research and guidance on mine health and safety. https://www.mhsc.org.za/

Statistics South Africa. Mining production, GDP and employment statistics. https://www.statssa.gov.za/

Minerals Council South Africa. Facts and Figures publications. https://www.mineralscouncil.org.za/industry-news/publications/facts-and-figures

SARS. Mineral and Petroleum Resource Royalty. https://www.sars.gov.za/types-of-tax/mineral-and-petroleum-resource-royalty/

ECSA. Engineering education and professional categories. https://www.ecsa.co.za/

Image credit - Business News Australia. Drill-core photograph used in Section C. https://www.businessnews.com.au/article/venture-adds-rare-earths-to-tasmanian-tin-play

Image credit - A.M. King. Flotation-cell photograph used in Section F. https://inventory.amking.com/

Image credit - Canyon Coal. Bekezela public-participation photograph used in Section G. https://www.canyoncoal.com/latest-news-and-announcements/bekezela-public-participation-meeting-attended-by-ward-12-community

FUNDAWAY

Learn Today, Achieve Tomorrow. Correct every error, revise the linked topic note and attempt the challenge again without the memo.