

SECTION A

PART I: Multiple Choice Questions [30 marks]

Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g. 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. As per the Mines and Mineral Management Act 1995 and its Regulation, the permissible ultimate pit slope of mining benches on hard rocks allowed in Bhutan is
 - a) 65 degree
 - b) 45 degree
 - c) 60 degree
 - d) 50 degree

2. What is a crimper?
 - a) A tool to make holes in the explosives.
 - b) A tool to bind safety fuse and detonators together.
 - c) A tool to detect cracks in the blast holes.
 - d) A tool to explode the explosives.

3. Powergel is a
 - a) Primary explosive
 - b) Secondary explosive
 - c) Tertiary explosive
 - d) Safety fuse

4. Transportation of minerals and rock in a truck is only allowed after the transporter seeks _____ documents from the authorized officials.
 - a) performa invoice
 - b) transport permit
 - c) cash memo
 - d) form B

5. What are the major raw materials required for production of cement?
 - a) Limestone, Gypsum, Sandstone and Coal.
 - b) Limestone, Quartz, Sandstone and Dolomite.
 - c) Limestone, Gypsum, Sandstone and Iron Ore.
 - d) Limestone, Quartzite, Iron Ore and Dolomite.

6. A bench has a length of 200 meters, width and height of 5 meters. How much material can be excavated if the whole bench is blasted for extraction? (Note: Specific gravity of the material is 2.65)
 - a) 13,200 MT
 - b) 12,000 MT
 - c) 5000 MT
 - d) 13,250 MT

7. As per the MMMA 1995 and its Regulation, the maximum hour a worker can work continuously at one go before taking rest is
- 5 hours
 - 6 hours
 - 7 hours
 - 8 hours
8. A horizontal coal deposit of 15 meters thickness with 500 meters strike length is found below 200 meters sub-surface on a flat topography. What type of mining method would you apply to win the coal?
- Adit mining
 - Open cast mining
 - Drifting
 - Underground mining
9. What is Placer Mining?
- Mining method adopted to do mining in steep topography.
 - Mining method adopted to do mining in plain topography.
 - Mining method by using water to excavate, transport, concentrate, and recover heavy minerals from alluvial deposits.
 - Mining method to excavate heavy minerals.
10. A proposed mining has a deposit of 1.2 million MT of rocks. The stripping ratio (ore: overburden) estimated for the deposit is 1:0.35. What would be the volume of overburden for the whole deposit if it is excavated?
- 320,000m³
 - 450,000m³
 - 420,000m³
 - 480,000m³
11. What is fossicking?
- A mining method to mine precious metals.
 - A mining method to locate the petroleum.
 - A mining method adopted to collect semi-precious and precious gemstones.
 - A mining method to mine diamonds.
12. Hematite is an ore for which one of the following metal?
- Copper
 - Gold
 - Tungsten
 - Iron
13. In Bhutan, iron ore is mined at Lhamoizingkha under Dagana Dzongkhag. As per rule, it is not allowed for export and it is supplied only in domestic market to manufacture which one of the following product?
- Ferro alloys
 - Cement
 - Sponge Iron
 - Calcium Carbide

14. In an open cast mine, the width which is extracted from the working bench is termed as
- Bench width
 - Bank width
 - Cut
 - Bench face
15. The source of energy for Pneumatic Jackhammer is
- Diesel
 - Electricity
 - Kerosene generator
 - Compressed air
16. What do you mean by relieving hole?
- A hole in the mining bench to keep explosives.
 - A hole drilled adjacent to blast hole to treat misfire.
 - A hole drilled to blast a mine bench.
 - A hole drilled to blast the mine bench face.
17. If a mine lease area is 30 acres, what would be its area in hectare?
- 12.44 hectares
 - 12.14 hectares
 - 14.12 hectares
 - 14.14 hectares
18. Coal seam/deposits are usually found in
- Igneous rock
 - Sedimentary rock
 - Metamorphic rock
 - Lunar rock
19. Which one of the following mineral is not mined in Bhutan?
- Dolomite
 - Limestone
 - Quartz
 - Quartzite
20. What is the full form of GPS?
- Global Position System
 - Globe Position System
 - Global Positioning System
 - Global Partition System
21. Which one of following is the use of tailing dams in opencast mines?
- A dam constructed to check the erosion of soil down the slope.
 - A dam to check the runoff water flowing out from the mine area.
 - A dam constructed along the base of a waste dump to check the spillage of waste.
 - a dam used to store the waste byproducts produced during the process of extracting the valuable commodity/product from an ore.

22. Which one of the following is high grade coal?
- Anthracite
 - Brown Coal
 - Bituminous Coal
 - Sub-bituminous
23. Which one of the following is the primary content of an ordinary detonator?
- PETN
 - Gunpowder
 - ANFO
 - Lead Azide
24. As per the Mines and Mineral Management Act 1995 and its Regulation, a mining lease shall lapse automatically if the promoter does not operate the mine/quarry within a period of _____ from the date of signing the lease agreement.
- 1 year
 - 2 years
 - 3 years
 - 4 years
25. As per the Mines and Mineral Management Regulation 2002, a Mines Inspector is authorized for all of the following EXCEPT
- Call for and examine all reports, registers and records required to be maintained by all holders of a mining lease.
 - Visit, enter, inspect and examine, with or without previous notice, all facilities related to operation directly or indirectly related to a mining lease.
 - Investigate the circumstances surrounding an accident, dangerous occurrence, or activity connected with the health and safety of workers or the public.
 - Prepare FMFS Report for the promoter, make necessary changes in the mine plan, prepare monthly and annual report of the mine/quarry for Promoter.
26. All of the following are accessories in ordinary detonator blasting EXCEPT
- Crimper
 - Scraper
 - Detonator
 - Wooden Stick
27. A mining company has target to excavate 1000 MT of ore materials in one day. However, the Company has only Jackhammer to drill the blast hole. A Jackhammer takes 10 minutes to make one drill hole. Approximately, how many Jackhammers are required to excavate the targeted quantity of material?
- Note: A blast hole can excavate 20.82 MT per one blast and as per job routine a blaster has only 2 hours to make the hole in one day.*
- 1 Jackhammer
 - 3 Jackhammers
 - 4 Jackhammers
 - 5 Jackhammers

28. Marble slabs cannot be produced from deposit of marble in Bhutan because
- all marble deposits in Bhutan are white in colour.
 - there is no homogenous marble deposit in Bhutan and it is mostly fractured.
 - quality of marble in Bhutan is very low.
 - all marble deposits are located in high altitude.
29. Which one of the following mineral is acceptable for human consumption as food additives?
- Limestone
 - Gypsum
 - Dolomite
 - Quartz
30. When is some limestone deposit called as dolomitic limestone after doing the lab analysis?
- When limestone deposit has more percentage of calcium oxide.
 - When limestone deposit has more percentage of calcium carbonate.
 - When limestone deposit has more percentage of iron oxide.
 - When limestone deposit has more percentage of magnesium oxide.

PART II – Short Answer Questions [20 marks]

This part has 4 Short Answer Questions. Answer ALL the questions. Each question carries 5 marks.

- Suppose you are a mining engineer working at Gidaphu Marble Mine located in Thimphu Dzongkhag. Draw an imaginary Mine Plan of the mine for 2nd year operation showing all the important features.
- Identify major environmental pollution while operating a mine/quarry and explain some of the mitigation measures.
- What are some of the major parameters you need to consider while preparing a Final Mines Feasibility Study (FMFS) report of a mine or quarry?
- What are some of the advantages of doing open cast mining?

SECTION B: CASE STUDY [50 marks]

Choose either Case I or Case II from this section. Each case study carries 50 marks. Mark for each sub-question is indicated in the brackets.

CASE I

Assume that you are a consulting mining engineer. You are hired by a potential mining Promoter to carry out Pre-Feasibility Study (PFS) of a stone deposit located at Tading under Samtse Dzongkhag and prepare a PFS Report for onward submission to Department of Geology & Mines. Following the site visit with your associate geologist, the site is found feasible for operation as stone quarry.

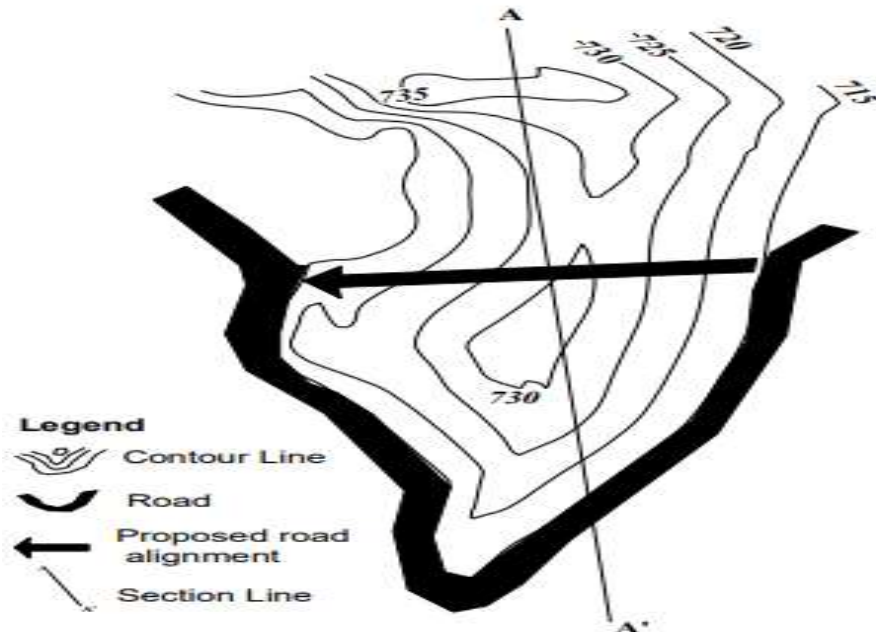
Following assumptions are being made;

- Construction material found in the area is grey quartzite.
 - Mineable reserve of the quartzite deposit is 2.5 million MT
 - Average thickness of overburden is 5m distributed over an area of 300 X 300m².
 - The site was accessible by a farm road till its base and an additional access road of 0.5 km is required to be constructed to reach the top of the deposit.
 - The proposed site is a gentle sloping protruding ridge with dry depression on both the side.
1. As per the Mines and Mineral Management Act 1995 and its Regulation, what are the steps involved or formalities to be completed from first till last while you process for a mining lease? (10 marks)
 2. Following the assumption made above, please prepare an imaginary PFS report for the above deposit. You can also make your own assumption other than above where applicable while preparing the report. (20 marks)
 3. Assume a suitable place as dump yard (ideal dump yard) and illustrate the dumping design with an appropriate diagram. Explain why you have chosen such location. (10 marks)
 4. What type of mining method will you recommend and why? Also mention about the type of machineries and equipment you recommend to deploy with justifications. (10 marks)

CASE II

The Government is carrying out widening of highway from west to east of Bhutan. The Department of Roads (DoR) is shortening the curve highway on a hill slope, where ever possible, by adopting Box-Cut method of excavation of rocks and soil present (for example, refer the diagram below).

However, DoR can excavate till the Road Right of Way (RRoW), that is 50 feet from the center of road and any excavation beyond 50 feet or any other heavy excavation has to be forwarded to the Department of Geology & Mines for regularization. Thereby, the whole operation of shortening of the highway has to be considered or processed as quarrying by adopting Box-Cut method.



1. What do you understand by Box-cut method of quarrying? Explain it with the help of a cross-sectional diagram with all the important features. You can use the above map to make cross-section along A to A' to illustrate your answer (10 marks)
2. What are the different types of mining method adopted in the world? Explain each one briefly if possible with diagram and sketches. (10 marks)
3. Why underground mining is not done in Bhutan? (5 marks)
4. If the DoR intends to use the material found between the Box-cut and all along the curve road for road maintenance by making the said area flat till road level, what method would you adopt to excavate the material? (10 Marks)
5. If you are asked to prepare the Mine Restoration Plan of the area after making the area flat, what would you suggest to reclaim the excavated part of the area? (5 marks)
6. What precautionary/mitigation measure would you suggest to keep the slope of Box-Cut area stable? Explain it with the help of a diagram wherever possible. (5 marks)
7. What is the most common method of mining adopted in Bhutan? Give reasons. (5 marks)

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