

**ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2015
EXAMINATION CATEGORY: TECHNICAL**

PAPER III: SUBJECT SPECIALIZATION PAPER for *Geology*

Date	: 11 October 2015
Total Marks	: 100
Examination Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to examination time)

GENERAL INSTRUCTIONS:

1. Write your Roll Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is being provided to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A and SECTION B:
 - **SECTION A** has two parts: Part I - 30 Multiple-Choice Questions
Part II - 4 Short Answer Questions
All questions under SECTION A are COMPULSORY.
 - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions under your choice.
4. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating any or correct Section, Part and Question Number will NOT be evaluated and no marks would be awarded.
5. Begin each Section and Part in a fresh page of the Answer Booklet.
6. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
7. Use of any other paper including paper for rough work is not permitted.
8. You are required to hand over the Answer Booklet to the Invigilator before leaving the examination hall.
9. This paper has 07 printed pages in all, including this instruction page.

GOOD LUCK!

SECTION A

PART I - Multiple Choice Questions (30 Marks)

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

1. The word “geology” is derived from the Greek words “geo”, meaning (1) _____ and “logis”, meaning (2) _____.
 - a. planetary (2) study
 - b. Earth (2) science
 - c. rock (2) logic
 - d. rock (2) perception
2. Most modern geologic study is based on the precept of the Principle of Uniformitarianism, which states:
 - a. the present is the key to the past
 - b. the past is the key to the future
 - c. the past repeats itself
 - d. the past’s future is the same as the future’s past
3. A short break in time during sediment deposition, or a small change in the sedimentary facies, results in the creation of a/an:
 - a. unconformity
 - b. angular unconformity
 - c. bedding plane
 - d. nonconformity
4. In sedimentary rock types, the term **clastic** means the same thing as:
 - a. chemical
 - b. biochemical
 - c. biogenic
 - d. detrital
5. Which of the following is NOT a mineral commonly produced by evaporation of seawater?
 - a. halite
 - b. limestone
 - c. gypsum
 - d. calcite

6. Which of the following correctly describes the process that occurs during lithification?
- partial melting
 - diagenesis
 - metamorphism
 - metasomatism
7. The three main classes of rocks are classified by how they formed. (1) _____ rocks form from molten rock. (2) _____ rocks form by surface processes. (3) _____ rocks form from existing rocks that are changed by pressure and temperature.
- igneous (2) sedimentary (3) metamorphic
 - igneous (2) metamorphic (3) sedimentary
 - sedimentary (2) metamorphic (3) igneous
 - none of the above combinations
8. Molten rock inside the earth is called (1) _____ but on the surface it is called (2) _____.
- lava (2) magma
 - lava (2) extrusive
 - intrusive (3) magma
 - magma (2) lava
9. The type of magma that contains the most silica is:
- felsic
 - intermediate
 - mafic
 - it depends on the temperature
10. Which of the following types of lava has the lowest viscosity and therefore flows the fastest and furthest?
- intermediate
 - mafic
 - ultrafelsic
 - intermafic
11. What controls the **size** of crystals that form an igneous rock?
- magma chemistry
 - rate of cooling
 - types of minerals
 - Bowen's reaction series
12. A foliation develops in a metamorphic rock because:
- platy minerals always align with each other during any type of metamorphism
 - differential stress causes minerals to align parallel to each other

- c. high temperatures during metamorphism always cause minerals to recrystallize with a foliation
 - d. this is what defines a metamorphic rock in the first place
13. In the lists of metamorphic rocks below, which one shows rocks in the correct order from lowest to highest metamorphic grade for an initially clay-rich rock?
- a. slate - phyllite - schist - gneiss
 - b. slate - schist - phyllite - gneiss
 - c. schist - phyllite - slate - gneiss
 - d. gneiss - schist - phyllite - slate
14. Metamorphism of limestone produces:
- a. granulite
 - b. hornfels
 - c. quartzite
 - d. marble
15. The main driving force behind **mass wasting** is:
- a. ice
 - b. wind
 - c. gravity
 - d. human stupidity
16. The steepest slope that can be produced by a pile of unconsolidated sediment is called the:
- a. angle of concern
 - b. angle of repose
 - c. angle of mass wasting
 - d. angle of cohesion
17. The type of landslide that involves slow sliding of sediment above a concave slip surface is called:
- a. a slump
 - b. a rock slide
 - c. a mudflow
 - d. a debris avalanche
18. A rock with a density that is five times greater than the density of water would have a density of:
- a. 5 kg
 - b. 5 g/cm³
 - c. 500 lbs
 - d. water has no density

19. The lithosphere is made up of:
- solid rock that behaves in a soft and squishy manner, like salt water taffy
 - the crust and the uppermost part of the mantle
 - the highest density rocks of all the Earth's internal layers
 - continental crust and oceanic crust only
20. The three primary types of tectonic plate boundaries are:
- normal, reverse, and strike-slip
 - active, passive, and extinct
 - divergent, convergent and transform
 - seismic, volcanic, and sub ducting
21. In an atom, the particles with negative, positive, and neutral charges (in that order) are:
- electrons, protons, neutrons
 - protons, electrons, neutrons
 - neutrons, electrons, protons
 - positrons, negatrons, morons
22. If all minerals MUST be inorganically formed, which of the following substances cannot possibly be a mineral?
- ice
 - mica
 - quartz
 - coal
23. What type of chemical weathering is analogous to rusting, causing the iron in rocks to turn reddish?
- oxidation
 - hydrolysis reactions
 - dissolution
 - exhumation
24. An example of a trace fossil:
- leaf imprint
 - fossils of marine organism shells
 - fossilized bird bones
 - dinosaur footprint
25. Which of the following metamorphic rocks is most likely to be produced by intermediate-grade metamorphism of shale?
- schist
 - quartzite

- c. slate
 - d. gneiss
26. For rocks that are being deformed inside the crust, as the temperature increases:
- a. the rocks get more brittle
 - b. the rocks get less brittle
 - c. the rocks get less ductile
 - d. the strain rate increases
27. The southernmost part of Bhutan is occupied by rocks of:
- a. Surey Gneissic complex
 - b. Buxa Group of Rocks
 - c. Shumar Formations
 - d. Siwalik Formation
28. The Thimphu Formation consist of:
- a. Quartzite
 - b. Dolomite
 - c. Phyllite
 - d. Gneisses
29. In Bhutan Coal is obtained from:
- a. Tethyan Sequence
 - b. Chekha Formation
 - c. Gondwana Formation
 - d. Tirkhola Formation
30. The largest Cement plant in Bhutan is located in:
- a. Samtsi Dzongkhag
 - b. Chukha Dzopngkhag
 - c. Pemagatsel Dzongkhag
 - d. Punakha Dzongkhag

PART II – Short Answer Type Questions (20 Marks)

Answer ALL the questions. Each question carries 5 marks. Mark for each sub-question is indicated in the brackets.

1. Name the Stratigraphy of Bhutan Geology starting from the youngest Formation to the oldest Formation? (5)
2. How many Cement plants are there in Bhutan and which is the largest cement plant, and what is the main raw material for Cement? (5)
3. There are number of Ferrosilicon plants in Bhutan mostly clustered in Pasakha Industrial Estates, Phuntsoling Dungkha, Chukha Dzongkhag and one ferrosilicon plant is located in Martanga, Samdrupjhongkhar Dzongkhag. What is the main raw material for Ferrosilicon and in which geological Formation in Bhutan, this material is found? (5)
4. How many auctioned mines are there in Bhutan, and which are these mines and where are these mines located? (5)

SECTION B

Case Study

Choose either Case 1 or Case 2 from this Section. Each Case carries 50 marks. Mark for each sub-question is indicated in the brackets.

CASE 1

Our country Bhutan is blessed with huge deposit of dolomite. The mineral dolomite is used as raw materials for production of magnesium metal, making of dolomite bricks and as soil conditioner in the tea gardens. The Department of Geology and Mines have a plan to explore dolomite deposit region wise. Now you are assigned as a principal prospector for dolomite deposit in Southern Bhutan. Write geological exploration report of the dolomite deposit in Samtse areas. Your report should contain INTRODUCTION, Physiographic, Flora and Fauna, Previous Work, regional geology and geology of the deposit areas. (50 marks)

CASE 2

Bhutan is also having a lot of Gypsum deposit in Khotakpa areas, Pemagatse Dzongkha. You have been assigned to take up the geological exploration work of Gypsum deposit. Now you write an interim geological report on gypsum deposit. The content of the report should be as follows: INTRODUCTION, The gypsum Occurrence, USES OF GYPSUM, METHODOLOGY AND OBJECTIVES, Mapping and Geology of the areas. (50 marks)