Combined Geo-Scientist (Main) Examination, 2024

SGSE–O–HDG

HYDROGEOLOGY

Time Allowed : Three Hours	Maximum Marks : 200

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions

There are **NINE** questions divided under **FIVE** Sections.

Candidate has to attempt **FIVE** questions in all.

The **ONLY** question in Section—A is compulsory.

Out of the remaining **EIGHT** questions, the candidate has to attempt **FOUR**, choosing **ONE** from each of the other Sections B, C, D and E.

The number of marks carried by a question/part is indicated against it.

Symbols, abbreviations and notations have their usual standard meanings.

Neat sketches are to be drawn to illustrate answers, wherever required.

Wherever required, graphs/tables are to be drawn on the Question-cum-Answer (QCA) Booklet itself.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly.

Any page or portion of the page left blank in the Question-cum-Answer (QCA) Booklet must be clearly struck off.

Answers must be written in **ENGLISH** only.

SECTION—A

(Compulsory Section)

1. Write short notes on the following in not more than *5* sentences each : 5×8=40

(a) Secondary porosity

(b) Specific retention

(c) Storage coefficient

(d) Intrinsic permeability

(e) Cone of depression

(f) Magnetometer

(g) Well completion

(h) Leachate

SECTION—B

Attempt *any* **one** question

2. *(a)* Define aquifer and classify aquifers depending on the presence or absence of a water table. 15

(b) Discuss how the rock formations affect groundwater. Describe with neat sketches. 15

(c) How do thermal springs form? What are their implications? 10

3. *(a)* Explain the derivation of Darcy's law using the diagram of experimental setup. Add a note on the equation and its application in groundwater flow studies. 15

(b) Define hydraulic conductivity. Give an outline on the methods of determining hydraulic conductivity in the laboratory and in the field. Explain any one of the laboratory methods. 15

(c) What is meant by aquifer transmissivity? Explain its relationship with the other aquifer properties and thickness of saturated aquifer media with an example. 10

SECTION—C

Attempt *any* **one** question

4. *(a)* Explain the Bernoulli equation and its application in groundwater studies. 10

(b) Explain the terms advection, adsorption, diffusion and dispersion. Add a note on their interrelationships. Discuss about their effects in groundwater systems. 15

(c) In an aquifer system of 10000 sq. m flat area, the depth to the basement is 100 m below ground level (bgl). The specific yield (sy) is 0·01. The water levels measured during pre- and post-monsoon are 40 m and 20 m bgl. Determine *(i)* the volumes of water in aquifer storage during pre-monsoon and post-monsoon and *(ii)* the change in groundwater storage due to monsoon. 15

5. *(a)* Describe the mechanisms of interactions between stream flow and groundwater flow using appropriate illustrations. 10

(b) Explain the purpose of conducting pumping tests. Describe the stage-wise procedures involved and the measurements recorded while conducting these tests. 15

(c) What are the two major causes inducing land subsidence? Highlight their role along with porous media properties. 15

SECTION—D

Attempt *any* **one** question

6. *(a)* How do you explore groundwater using electrical resistivity method? 15

(b) How do the surficial features identified on aerial photographs help in evaluating groundwater conditions? 15

(c) What are the different recognised levels of groundwater management studies generally carried out by local government agencies? 10

7. *(a)* Briefly describe seismic refraction method in exploration of groundwater with neat sketches. 15

(b) Describe a test drill. Add a note on geologic log and its implications. 15

(c) Write short notes on the following :

(i) Radiation logging

(ii) Water dowsing 10

SECTION—E

Attempt *any* **one** question

8. *(a)* How does freshwater occur in coastal regions? Explain the upcoming phenomenon. 15

(b) What are the uses of stable and radioactive isotopes? Discuss the radioactive isotopes for the determination of the age of groundwater. 15

(c) A water sample contains 300 mg of $CaSO_4$/litre. Calculate the hardness in terms of $CaCO_3$ in mg/L. 10

9. *(a)* What is the difference between natural and artificial recharge? Explain various methods of artificial recharge with sketches. 15

(b) Explain how sodium is important in irrigation water classification. Add a note on cation-exchange process. 10

(c) The following is the analytical data of a groundwater sample :

Sl. No.	*Chemical constituent*	*Units,* mg/L	*Atomic weight*
1	Calcium	200	40·08
2	Magnesium	125	24·32
3	Sodium	1300	23·00
4	Potassium	15	39·10
5	Chloride	2300	35·56
6	Sulphate	240	96·06
7	Nitrate	92	62·01
8	Bicarbonate	330	61·01

(i) Check the accuracy of the analysis.

(ii) What is the electrical conductivity (EC) value? 15

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