

5. Give a short account of the allotropic forms of carbon. How can it be proved that they are only different forms of the same elementary substance?

6. Show by a comparison of their chemical and physical properties that chlorine, bromine, and iodine may reasonably be regarded as members of the same family of elements.

7. When hydrogen and chlorine are exploded no permanent change of volume is produced. What theoretical deduction as to the molecular state of chlorine and of hydrogen can be made from this observation?

8. How is sulphuric acid manufactured? What is the action of the cold dilute and the hot concentrated acid upon zinc, copper, and potassium ferrocyanide respectively?

9. Give a short account of the chemistry of arsenic, and explain any method whereby the presence of arsenic in a solution may be detected.

*Biology.—For Class D, and for Senior and Junior Civil Service. Time allowed: 3 hours.*

[Candidates must answer questions in one branch of the subject only. All answers must be illustrated, where possible, by diagrams.]

#### I. ANIMAL PHYSIOLOGY.

1. What do you understand by protoplasm? Give some account of its characteristics. What part of the body would be most suitable for examining protoplasm?

2. What is a nerve; and what physiological relation has a nerve (*a*) to a muscle on the one hand, and (*b*) to the central masses of the nervous system on the other?

3. Write a short account of the blood. Describe the general course of the circulation of the blood in a vertebrate animal—say, the frog, or man.

4. Describe the lungs, their structure, their situation in the body, and their relations to other organs. How are the lungs filled and emptied; and what purposes do they serve?

5. By what parts of the body are the following chemical substances removed: Carbonic acid, and deleterious nitrogenous matters? Give a brief account of the organ or organs you mention.

6. Write a description of a hen's egg. Point out, as far as you can, what purpose is served by each of the various parts, and what finally becomes of it. What is the first traceable change in the development of the egg into a chick?

7. A meal consists of a fat mutton chop, potatoes, beans, rice pudding, bread, and cheese. Refer these to their proper categories as "food-stuffs" in a chemical sense, and trace the changes that each undergoes in its course along the alimentary canal.

#### II. BOTANY.

1. Write an account of a plant "cell" such as occurs in the "mesophyll" of a leaf. What modifications of the cell would you find in (*a*) the vascular bundle, (*b*) the parenchyma of the stem, and (*c*) the epidermis?

2. What are the chemical elements necessary for the building up of new living plant material? How and whence does a green plant obtain these various substances?

3. Describe carefully a complete transverse section of the stem of such a plant as the bean (or any other with which you are familiar). State the functions of all the various structures you describe.

4. Give an account of the anatomy of any flower with which you are familiar. Point out the functions of the various parts as far as you can.

5. Write an account of the structure of a fully developed ovule. What changes take place in it on becoming a seed, and what starts these changes?

6. State in general terms what you understand by a fruit. Describe in technical language the fruit of the following: Bean plant, buttercup, daisy, cherry, gooseberry; and indicate clearly what parts of the flower are involved in each instance.

7. Write an account of either of the orders (1) *Leguminosæ*, or (2) *Myrtaceæ*, or (3) *Scrophularineæ*, with especial reference to their representatives in New Zealand.

*Music.—Time allowed: 3 hours.*

#### INSTRUCTIONS TO CANDIDATES.

(*a*.) For the sake of uniformity it is requested that the notes of the scale be referred to by their Tonic Sol-fa names—Doh, Ray, Me, Fah, Soh, Lah, Te—or their initial letters.

(*b*.) The Tonic Sol-fa terminology is used throughout this paper as being the more generally known among school teachers; but, where considered necessary, explanations in ordinary musical language are given in brackets, thus: "Three-pulse measure [Triple time]."

(*c*.) Answers requiring the use of the staff notation may be written in their proper place in the body of the paper, candidates ruling their own staves.

(*d*.) All candidates are expected to attempt the practical work (Question 13). The time and tune tests may be taken in either notation.

1. Describe briefly the construction of the diatonic major scale, and draw a modulator [scale diagram] of one octave to illustrate it.

2. In what order would you teach the tones of the Doh chord? In what order would you subsequently add the remaining tones of the scale?

3. Mention some of the causes of flat singing, and say how you would deal with this difficulty in classes of children.

4. How would you begin the important subject of ear training?

5. By what means would you endeavour to get sweetness and good tone in school singing?