

*Elementary Science.—For Class E. Time allowed: Three hours.*

[Illustrate your answers by diagrams, wherever possible.]

1. What experiments would you make to show the difference between a chemical compound and a mechanical mixture?
2. How would you prepare hydrogen gas? What experiments would you perform to show its properties?
3. What is meant by the temperature of a body? How would you proceed to graduate a thermometer. Express the temperatures  $0^{\circ}\text{F.}$ ,  $54^{\circ}\text{F.}$ , and  $39^{\circ}\text{F.}$  in the Centigrade notation.
4. How would you proceed to show that the specific heat of lead is much smaller than that of water? Distinguish between specific heat and latent heat.
5. How would you set to work to measure the velocity of sound in air? Compare the velocities of sound in air and in water.
6. Define echo, pitch, and resonance.
7. Describe the construction and the use of the Leyden jar.
8. Describe the different ways in which pieces of (a) iron and (b) steel can be made into magnets.
9. Explain what happens when a ray of light is passed through a prism of glass.
10. Draw a system of pulleys, and show what is its mechanical advantage—neglecting friction and the weight of the rope and pulleys.
11. How do plants obtain their food?
12. Describe the position, form, and function of every organ that lies in contact with either surface of the diaphragm.

*Elementary Experimental Science.—For Class D. Time allowed: Three hours.*

[Illustrate your answers with diagrams, wherever possible.]

1. What experiment would you make to illustrate the parallelogram of forces?
2. How would you obtain the "real coefficient of expansion" of mercury? When a liquid is heated in a glass vessel, what relation has its apparent to its real expansion? Establish an expression for this relation.
3. Show how the latent heat of steam may be measured.
4. Describe some experiments to show that sound is due to vibration.
5. A musical note is distinguished by pitch, intensity, and character: explain what is meant by each of these.
6. How would you make a voltaic cell? What changes take place within the cell when the external circuit is completed? How would you arrange a battery of six cells so as to maintain the largest steady current in an external circuit of given resistance?
7. Explain the principle of a dynamo-electrical machine.
8. Describe accurately the solar spectrum. What do you know of the laws of the refraction of light?
9. How would you prepare chlorine? Give an account of the changes that take place during the process. What experiments would you perform to illustrate the affinity of chlorine for other elements?
10. Give a brief account of the various forms in which carbon occurs. By what experiments would you demonstrate that they are forms of one and the same substance?
11. What relation has the quantity of fluid excreted by the skin to the weather? How is the variation compensated?

*Geology.—For Civil Service Senior. Time allowed: Three hours.*

1. What is meant by the "crust" of the earth? Give a full description of any typical portion of the earth's crust. Discuss the appropriateness of the term "crust."
2. Where are foliated schists found in New Zealand? What do you know of their mineralogical composition, age, and probable origin?
3. Why should the nature of the fossils that occur in any system of rocks be a satisfactory criterion of the age of the system?
4. A district of level land is found to be composed of stratified rocks, dipping  $\text{W. } 60^{\circ}$ . The nature of the rocks changes gradually as they are traced from E. to W. from coarse conglomerate to fine shale. Towards the N.W. the shales are spotted, and in the extreme N.W. of the district contain crystals of chialstolite and staurolite. Trace the complete geological history of the district.
5. What is limestone? How is it distinguishable from marl and from marble? Describe the different ways in which limestone may be formed. Give any New Zealand examples with which you may be acquainted.
6. A given mineral belongs by its form to the cubic (isometric) system. Its colour is lead grey; specific gravity, 7.5; hardness, 2.5. In general form it is octahedral, but the edges are replaced by faces equally inclined to the adjacent octahedral faces. The corners also are replaced by other faces equally inclined to the four adjacent octahedral faces. Name the mineral, indicate the form of the replacing faces, and explain all the technical terms used in this question.

*Botany.—For Civil Service Junior. Time allowed: Three hours.*

[Illustrate your answers, wherever possible, by fully labelled diagrams.]

1. In a transverse section of any leaf enumerate in their proper order the "tissues" which will be cut through. Give a detailed account of the cells that are characteristic of each of these tissues.