4. State exactly how you would show that a thread of glass when dry is a good insulator, but that when moist it conducts electricity, and that a thread of fused quartz is an insulator whether dry or moist.

5. In making Faraday's ice-pail experiment, what effect, if any, would result from the presence of points on the outside of the ice-pail?

6. What is the object of amalgamating a zinc plate for a galvanic cell? Explain precisely how you would carry out the operation.

7. Describe a Daniell cell and a Leclanché cell. For what purposes is each of them best suited?

8. Describe the construction of an ordinary electric bell.

Magnetism and Electricity.—For Civil Service Senior. Time allowed: Three hours.

1. What hypotheses have been put forward to account for the magnetic properties of iron? What experiments may be made in support of any one such hypothesis?

2. Make a sketch of the lines of force in the field of a horseshoe magnet. What modification of the lines will result from the application of a keeper to the magnet? How would you ascertain whether a given steel ring was magnetised or not?

3. Explain how you would determine the declination (or variation) of the magnetic needle at a given place.

4. How could you conveniently ascertain which of two short threads was the better insulator?

5. How would you make a gold-leaf electroscope? Explain exactly how you would (*a*) cut out and fix the gold leaves, and (*b*) provide for the proper insulation of the conductor to which the leaves are fixed.

6. Define the C.G.S. electrostatic units of quantity, of potential difference, and of capacity. Show that the capacity of a sphere, the radius of which is 8 cm., is represented in this system of units by the number 8.

7. Describe De La Rive's floating battery, and explain the significance of the experiments usually made with this instrument.

8. A storage cell of 2 volts electromotive force and 0·5 ohm internal resistance is connected by thick wires to a galvanometer of 45 ohms resistance, and the galvanometer is provided with a shunt the resistance of which is 5 ohms: find the strength of the current flowing through the galvanometer.

9. Explain the meaning of the following terms: Board-of-Trade unit, kilowatt, three-wire distribution.

Chemistry.—For Class D, and for Civil Service Junior. Time allowed: Three hours.

1. Describe any two experiments illustrative of the fact that chemical change does not involve any change in the total mass of the matter that takes part in it.

2. Explain in detail how you would ascertain whether a given metal is oxidized at ordinary temperatures (*a*) in moist air, (*b*) in dry air.

3. What are the chief properties of hydrogen gas? How would you show that the gas possesses each of the properties you mention?

4. What would be the weight and the volume (measured at normal temperature and pressure) of the gas resulting from the combustion of 10 grams of pure charcoal?

5. How would you prepare and collect a sample of ammonia gas, and how would you prove that it contained hydrogen?

6. In what respects do the properties of phosphorus resemble those of sulphur? How far does this resemblance extend to the respective compounds of these elements?

7. Some salts absorb water when exposed to the air, others lose water under the same circumstances. Describe the behaviour of sodium chloride, calcium chloride, potassium nitrate, sodium nitrate, and soda crystals in this respect.

8. What is the difference between white-lead and litharge, and how would you convert each of these substances into the other?

Chemistry.—For Civil Service Senior. Time allowed: Three hours.

1. In what way may physical conditions modify chemical reaction? Give instances of such influence of condition, and mention cases in which a change in the conditions may cause a reversal of the reaction.

2. Write a precise and detailed account of what you would do (*a*) to find the weight of copper which is equivalent to one gram of zinc; (*b*) to find the weight of copper which is combined with one gram of oxygen in the black oxide of copper.

3. A litre flask full of dry air is heated in an oven to 182° C. and closed with a tightly fitting stopper. It is then taken from the oven and surrounded with melting ice. What will be the pressure and what the weight of the air in the cold flask?

4. State the law which governs the volumes of combining gases, and describe any two experiments in illustration.

5. Explain exactly how you would estimate the amount of carbon dioxide in the air of a room. Describe, if you can, any special apparatus designed for this purpose.

6. Compare the properties of hydrochloric, hydrobromic, and hydriodic acid gases.

7. To what do you attribute the luminosity of a coal-gas flame. Describe experiments which may be made in support of your statement.

8. Give the formulæ of the chief oxides and salts of lead, and explain how you would prepare from metallic lead a small quantity of each of these substances.