2. Define the magnetic axis and the magnetic moment of a magnet, and explain two methods whereby the magnetic moments of two magnets may be compared.

3. State the laws of electrical attraction and repulsion. How can the truth of these laws be accurately demonstrated ?

4. What is meant by " an electrical condenser " ? What factors affect the capacity of a spherical condenser ?

Two similar condensers of unit capacity are respectively charged with two units and ten units of positive electricity ; they are then connected for a moment by a fine wire : what is the final potential of each condenser, and what is the initial and final energy of the system ?

5. Four Daniell cells are arranged in series, with two cells containing (a) a solution of copper sulphate and (b) a solution of sulphuric acid : give a quantitative account of the changes which occur in each part of the circuit during the solution of 1 gram of zinc in one of the Daniell cells.

6. Explain clearly the meaning of the terms " electrical resistance," " specific resistance," and " temperature coefficient." How would you determine the specific resistance of platinum at $0°$ C.?

7. The resistance of a galvanometer is 0.9 ohm : what is the maximum current which a combination of 20 cells, each having an internal resistance of 1 ohm and an E.M.F. of 1 volt, can send through it ? At what rate does the instrument absorb energy when the maximum current is flowing ?

No. 48.—Chemistry.—For Civil Service Junior.
Time allowed : Three hours.
[$H = 1$; $N = 14$; $Cl = 35.3$.]

1. How would you distinguish between—
(a.) Zinc oxide and slaked lime ;
(b.) Chalk and white lead ;
(c.) Black oxide of copper and manganese dioxide?

2. Mention three common oxidizing and three reducing agents, and give equations to illustrate the oxidizing and reducing action of each.

3. How is carbon dioxide prepared in a pure and dry state ? What are the properties of the gas and its chief industrial applications? How would you attempt to find out whether a sample of the gas contained nitrogen or not?

4. Show, by reference to water and ammonia, that a chemical formula is a symbol representing the quantitative composition of a compound together with the volume relations of the compound in the state of vapour to its gaseous constituents.

5. Give instances of gases and solids which are very easily soluble, moderately soluble, and sparingly soluble in water. What circumstances usually affect the solubility of gases and solids in a given liquid ?

6. What do you understand by acid, basic, and neutral salts? Give instances of carbonates belonging to each of these classes.

7. State shortly the most striking properties of hydrochloric, nitric, and sulphuric acids.

8. What weight of ammonia could be obtained from 100 grams of ammonium chloride ? What volume would the gas occupy at $100°$ C. and 700 mm. pressure ?

No. 49.—Chemistry.—For Class D.
Time allowed : Three hours.
[Atomic weights : $H = 1$, $O = 16$, $C = 12$, $Na = 23$, $Cl = 35.3$, $S = 32$.]

1. Explain how you would prove to a class that the liquid produced by burning hydrogen in air is really water.

2. What evidence is there that air is a mixture, and that hydrochloric-acid gas is a compound ?

3. How could you show that sulphuric acid contains each of the elements which enter into its composition ? Calculate the percentage composition of sulphuric acid.

4. Explain clearly the nature of the evidence for the statement that the three forms of carbon, though physically distinct, are chemically identical.

5. How would you distinguish between caustic soda, soda crystals, and bicarbonate of soda ? How can each of these compounds be prepared from common salt ?

6. What volume of hydrochloric acid measured at $0°$ C. and 760 mm. pressure could be obtained from 10 grams of common salt ? If the gas were dissolved in water, what weight of four-per-cent. solution of caustic soda would be required to neutralise it ?

7. What are blue and green vitrol ? A boiling solution of each of these substances is treated successively with sulphuretted hydrogen, nitric acid, and ammonia : what changes will occur in each case ?

8. What experiments would you perform if you were giving a lesson on ammonia ? Why is the formula NH_3 given to this compound ?

No. 50.—Chemistry.—For Class C and for Civil Service Senior.
Time allowed : Three hours.
[$H = 1$; $O = 16$; $S = 32$; $N = 14$.]

1. Describe in detail any experiment you would perform in order to illustrate the proposition that when a chemical reaction occurs there is no change in mass, but that there is generally a change in volume and an evolution of heat.