

3. What is meant by "latent heat"? Describe a method of determining the latent heat of water.
4. How many pounds of steam at 100°C . will be required to melt 20 lb. of ice at 0°C .?
5. Distinguish between transverse and longitudinal vibrations, and between progressive and stationary vibrations. Explain the phenomenon of resonance. A tuning-fork whose vibration number is 280 is mounted on a resonance box: what should be the length of the box?
6. Draw a diagram illustrating the formation of a virtual image by means of a convex lens. A lens of 6 in. focal length is used to throw upon a screen an image of an object magnified six times: at what distances from the screen must the lens and the object respectively be placed?
7. Explain the cause of colour in transparent and in opaque bodies. What are complementary colours? What is meant by "chromatic aberration"?
8. How would you magnetize a steel knitting-needle? What properties would it thereby acquire? Explain what is meant by "magnetic induction." How would you demonstrate experimentally the induction of the earth's field?
9. Describe the following instruments: the dip-circle, the electrophorus, the tangent galvanometer.
10. Give an account of the thermal effect of an electric current, stating the conditions that may modify that effect.
11. A Daniell's cell gives a current of 0.2 ampere through an external resistance of 5 ohms; but when the external resistance is increased to 10.5 ohms the current falls to 0.1 ampere. Find the internal resistance and EMF. of the cell.

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

1. State under the following heads what you know of acetylene: (a) the manufacture of it on the large scale, (b) its weight compared with the weight of an equal volume of air, (c) the number of gallons of air required to burn completely 100 gallons of it.
2. Show by equations the action of heat on the following compounds: Orthophosphoric acid, sulphuric acid, ammoniac chloride, arsenic hydride passing through a tube, arsenic hydride in the open air.
3. Give the names and formulæ of all acids that you know of that contain—(a) sulphur, (b) phosphorus, (c) chlorine, (d) boron.
4. State what you know of the process of manufacturing bromine from sea-water.
5. Describe two processes for making hydriodic-acid solution, giving the equations.
6. Describe experiments to determine the composition of water—(a) by weight, (b) by volume.
7. How would you prove by experiment that chlorine constitutes half the volume of hydrochloric-acid gas?
8. How many gallons of uncombined oxygen will be left after the explosion of 10 gallons of methane (firedamp) in a closed space with 110 gallons of air?
9. Define the following terms as used in chemistry, and give examples of their application: nascent, amorphous, dimorphous, isodimorphous, allotropic, equivalent, critical temperature, deliquescent, hygroscopic, monobasic acid, tribasic acid.

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

[N.B.—Candidates must answer questions in one branch of the subject only. All answers should be illustrated when possible, by diagrams.]

Animal Physiology.

1. What is a gland? Describe the glands of the human skin.
2. Describe the structure and functions of the spinal cord in man.
3. Describe the structure of the human eye.
4. State what happens to the constituent parts of a piece of bread-and-butter in the alimentary canal.
5. Describe and explain the differences between arterial and venous blood.
6. Explain what is meant by the terms "cell" and "tissue."
7. Describe the minute structure of bone.
8. How is it that the temperature of the human body is practically constant, notwithstanding changes in the temperature of the surrounding atmosphere?

Botany.

1. Give an account of the order *Compositæ*, with special reference to the New Zealand representatives thereof.
2. Refer the following plants to their respective natural orders, and describe the flower of each: fuchsia, clematis, sorrel (*Rumex*), veronica.
3. State what you know about chlorophyll and its functions.
4. Describe the mode of occurrence, structure, and functions of root-hairs.
5. Describe the minute structure of a foliage leaf.
6. Point out, with the aid of diagrams, the difference between epigynous, perigynous, and hypogynous flowers.
7. Explain what is meant by the terms "simple," "compound," "pinnate," "palmate," "stipulate," "petiolate," and "peltate," as applied to leaves.
8. Describe fully the structure of the seed of a bean (*Vicia*).