

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

1. State the law of the expansion of a gas by heat, supposing its pressure to remain constant. A gas occupies 1,200 cubic inches at the temperature of $-13^{\circ}\text{C}.$, what volume will it occupy at the temperature of $52^{\circ}\text{C}.$ under the same pressure?
2. Describe Hope's experiment for determining the temperature of maximum density in water.
3. Give full explanations of the following terms: *Unit of heat, specific heat, latent heat, radiant heat, absorption of heat, convection of heat.*
4. Steam at $100^{\circ}\text{C}.$ is led into 300 grammes of water at $0^{\circ}\text{C}.$, and when the water has risen $24\frac{1}{2}^{\circ}\text{C}.$ in temperature it is found to have gained 12 grammes in weight: what value does this give for the latent heat of steam?
5. What is meant by a "musical interval"? What names are given to the intervals between C and E and between C and G on the diatonic scale? If the frequency of C is 260, what are the frequencies of E and G?
6. Draw diagrams illustrating the formation of the image when an object is placed in front of a concave mirror.
An object 3in. high is placed in front of a convex mirror at the distance of 15in.: if the focal length of the mirror is 12in., find the position and height of the image.
7. What is the law of the variation of luminous intensity with respect to distance? How would you verify this law by means of a photometer?
8. Give descriptions of an *electrophorus*, an *electroscope*, a *galvanometer*, and a *voltmeter*.
9. Mention some different methods of magnetizing a steel bar. What properties does the bar thereby acquire?
10. State the law of electrical resistance in a uniform wire. What is the practical unit of resistance called, and how is it defined?
A glow lamp takes a current of 0.8 ampere when the electro-motive force between its terminals is 100 volts: what is the resistance of the lamp?

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

1. Given nitric acid and ammonia, explain—showing the equations—how you would make nitrous oxide.
2. Given manganese dioxide, common salt, common saltpetre, sulphuric acid, how would you make the following?—
(a.) Chlorine.
(b.) Hydrochloric acid.
(c.) Nitric acid.
(d.) Aqua regia.
Give the equations, and sketch the apparatus required in each case.
3. How would you determine whether a given mixture of various gases contains free oxygen?
4. Describe an experiment to show that *charcoal*, *plumbago*, and *diamond* are different forms of the same element.
5. Show by equations the chemical changes that take place when the following substances burn in oxygen: (a) Hydrogen; (b) sulphuretted hydrogen; (c) sulphur; (d) methane (marsh-gas); (e) iron; (f) coal; (g) phosphorus; (h) coal-gas.
6. Explain—giving the equations and stating the conditions—how hydrogen gas can be made and collected from—(a) Water; (b) sulphuric acid; (c) hydrochloric acid.
7. Explain clearly how the composition of the atmospheric air is modified by—(a) Living animals; (b) living plants; (c) the burning of fires.
8. How many grammes of pure carbonate of lime are required to yield 1,000 litres of carbon dioxide gas, taking 0.5 litre as the volume of 1 gramme of CO_2 and 40 as the atomic weight of calcium?
9. Describe experiments to show the chief properties of chlorine.

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

N.B.—Candidates are requested to answer questions in one subject only. All answers should be illustrated, as far as possible, by diagrams.

Animal Physiology.

1. Describe the composition and functions of blood.
2. State what you know of the structure and functions of the spinal cord.
3. Name and classify those food-substances which are necessary for the diet of a human being.
4. Describe fully the structure of the skin in man.
5. Name and describe the bones of the limbs in man.
6. Describe the structure of the human eye.
7. Describe the structure and arrangement of the human teeth.
8. What is digestion? Describe the structure and functions of the various glandular organs which take part therein.

Botany.

1. Give the distinguishing characters of the following natural orders, and mention examples of each: *Compositæ*, *Primulaceæ*, *Liliaceæ*, *Cruciferae*.
2. Draw diagrams to illustrate the typical structure of the flower in monocotyledons and dicotyledons respectively.