7. Find the relation of the power to the weight in the screw, neglecting friction.

What force is necessary to exert a pressure of 1,000lb. by means of a screw the thread of which makes 60 turns in the course of 7½in., and which is turned by an arm 18in. long?

8. State the conditions of equilibrium of a floating body.

A stone weighs 10oz., and its specific gravity is 2·5: what will it weigh when immersed in water? and what is the specific gravity of a liquid in which it weighs 7½oz.?

9. Enunciate Boyle's law, and show how it may be proved experimentally for a compression of air.

10. Describe the common pump.

The valve of a pump is 16ft. above the water in the reservoir; the length of stroke from valve to spout is 2ft.; and the diameter of the piston is 4in.: find the force requisite to raise the piston, taking the weight of a cubic foot of water as 1,000oz.

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

1. Describe the process of graduating a thermometer. Express the temperatures 100°, 0°, and −100° Fahrenheit in the Centigrade scale.

2. Define the coefficient of linear expansion. What relation has this coefficient to the coefficient of cubical expansion for the same substance?

Taking the coefficient of linear expansion of copper to be ·0000172, find the length of a copper wire which expands 1in. when its temperature is raised from −5° to 25°.

3. Describe a method of determining the specific heat of a liquid.

4. What is the velocity of sound in dry air under normal conditions? Is the velocity of sound affected by an alteration (1) in the pressure of the air, (2) in the temperature of the air, (3) in the humidity of the air? Give reasons for your answer in each case.

5. Explain the following terms used in reference to a concave spherical mirror: *Centre of mirror, centre of curvature, principal focus, virtual image.*

A candle-flame 1in. long is placed directly in front of a concave mirror, at a distance from it of 15in. The focal length of the mirror being 1ft., find the position and size of the image formed by the mirror.

6. A luminous object is placed on the axis of a double convex lens at a distance from the lens equal to twice the focal distance. Draw a neat diagram illustrating the course of the rays which go to form the image.

7. Define unit strength of a magnetic pole.

Two magnetic poles, each of 15 units strength, are placed 9 centimètres apart: what is the force which they exert upon one another?

8. What are the conditions of electrostatic induction? Describe the electrophorus, and explain its action.

9. What are the means adopted for obviating local action and polarisation in a voltaic cell? Describe Grove's cell and Daniell's cell.

10. The internal resistance of a Grove's cell is ·2 ohm, and it gives a current of ·45 ampère when its poles are joined by a wire of 4 ohms resistance: what is the E.M.F. of the cell?

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

1. In what respects do chlorine and bromine resemble each other?

2. Write down the names and symbols and atomic weights of all the non-metallic elements.

3. Write down the names and symbols (formulæ) of the compounds which hydrogen forms with (a) oxygen, (b) chlorine, (c) phosphorus, (d) sulphur.

4. How is sulphuretted hydrogen (H_2S) made for laboratory use?

5. State what you know about the bleaching and disinfecting properties of chlorine.

6. In what different ways could you make sulphur-dioxide (SO_2)?

7. Describe the process for the manufacture of nitric acid.

8. Describe the process for the manufacture of hydrochloric acid.

9. Explain clearly how you would prove that atmospheric air is a mixture of gases, and not a compound, and also that it contains carbon-dioxide (CO_2).

10. How would you prove that the breath of animals contains carbon-dioxide and water?

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

[*Candidate must answer Questions in one subject only.*]

ANIMAL PHYSIOLOGY.

[Alternative with Botany.]

1. What are the various uses of the skeleton? Give a description of any perfect joint.

2. What are the chief food-stuffs contained in a meal of steak and potatoes, and how are they digested? Does such a meal represent a good diet?

3. What changes does the blood undergo in the lungs? What is hæmoglobin?

4. Describe briefly the mechanism of the circulation. How is the circulation of the blood controlled, and what circumstances cause it to vary?

5. What do you understand by the tissues of the body? Describe the microscopic character of muscular and glandular tissue.

6. Give an account of the structure and more important functions of the skin.

7. What are the waste products of the system, and how are they removed from the blood?

8. How is the voice produced, and in what way does speech differ from voice?

4—E. 1A.