

5. Define *centre of gravity*. Show how the centre of gravity of a body may be determined experimentally. Explain the states of *stable*, *unstable*, and *neutral* equilibrium, giving the conditions of each state.

6. A thin rod, 6ft. long, has balls weighing 8lb., 10lb., and 12lb. attached to it at distances of 2ft., 4ft., and 6ft. respectively from one end. Find the position of the point at which the rod must be supported, the weight of the rod itself being neglected.

7. Find the relation of the power to the weight in the system of pulleys in which all the cords are attached to the weight.

8. What force would be required to roll a cask weighing a ton up an inclined plane 12ft. long and 4ft. high, neglecting friction, and what would be the pressure on the plane?

9. Show how to find the pressure at any point in a fluid at rest.

Having given that the specific gravity of mercury is 13.6, and that the weight of a cubic foot of water is 1,000oz., find the pressure per square inch at the depth of 20in. in mercury.

10. Explain the method of finding the specific gravity of a liquid by means of the hydrostatic balance.

A piece of glass weighs 180 grammes *in vacuo*, 108 grammes in water, and 99 grammes in a solution of copper sulphate. Find the specific gravity of the glass and of the solution.

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

1. Mention the chief effects produced on substances by heat. Indicate the effects which are suitable respectively for measuring change of temperature and quantity of heat.

2. Give the law of the expansion by heat of a gas which is kept at constant pressure.

A gas occupies 350 cubic inches at the temperature of 7° C. What is the temperature when its volume has increased to 375 cubic inches under the same pressure?

3. Define unit quantity of heat. How much heat will be absorbed in raising 50 grammes of water from 20° C. to the boiling-point and evaporating it at that temperature?

4. Describe the sonometer, and state the laws which the instrument is used to verify.

5. Give a full account of some method of comparing the intensities of two sources of light.

6. An object is placed on the axis of a concave mirror between the principal focus and the centre of curvature; draw a diagram illustrating the formation of the image.

A bright object stands at a distance of 8in. in front of a concave mirror of 12in. focal length; what is the character, position, and relative magnitude of the image?

7. State the characteristic properties of a magnet.

8. Explain how you would charge an insulated metal ball with positive and with negative electricity (1) by friction, (2) by induction.

9. Mention some different modes (1) of producing, (2) of detecting, an electric current.

10. A Daniell's cell gives a current of .2 ampere through an external resistance of 5 ohms. Taking the E.M.F. of the cell as 1.08 volt, find its internal resistance.

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

1. Write down the names and formulæ (symbols) of all the known oxides of each of the non-metallic elements.

2. State what you know of ozone, under the following heads: (a) How it exists in nature; (b) how it can be made; (c) how it resembles and differs from dioxide of hydrogen; (d) the tests for it.

3. For what purposes is sulphuric acid used in the arts and manufactures?

4. Describe the process for the manufacture of sulphuric acid on the large scale, giving equations to show the chemical changes.

5. Give the names and formulæ (symbols) of all the acids that contain the following elements: (a) Chlorine; (b) nitrogen; (c) sulphur; (d) phosphorus; (e) bromine.

6. For what reasons are chlorine, bromine, fluorine, and iodine classed together as one family?

7. In what respects do the three allotropic forms of carbon differ from each other? What is there to prove that they are really the same element?

8. How many gallons of atmospheric air are required for the complete combustion of 100 gallons of (a) hydrogen, (b) marsh gas or firedamp, CH_4 ? Show the working-out of this question.

9. Write down as many equations as you can to show how the following gases are made: Oxygen, hydrogen, chlorine, sulphur-dioxide.

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

[Candidates are requested to answer questions in one subject only.]

ANIMAL PHYSIOLOGY.

1. What is the composition of the blood? Describe the corpuscles found in the blood, and give some account of their functions.

2. What are the chief kinds of food required to nourish the body? To which classes of food-stuffs do starch and white of egg (albumen) belong, and how are they digested?

3. What is lymph, and in what parts of the body is it found? What are the functions of the lymphatic system?