

In what time will a force, equal to the weight of 5 lb., impart to a body of 40 lb. mass a velocity of 120 ft. per second, and what space will be passed over by the body during this time?

3. Define *work* and *energy*, and explain how they are measured.

A forty-pound cannon-ball is moving with a velocity of 1,200 ft. per second: find the amount of work which it is capable of performing.

4. Enunciate the "triangle of forces." Show that the principle of this proposition may be extended so as to apply to a polygon having any number of sides.

Two straight lines, AB and CD, bisect one another in O, and P is any point: show that the four forces represented by PA, PB, PC, and PD have a resultant which is represented by 4 PO.

5. Find the position of the centre of gravity of a uniform triangular plate.

Find the position of the centre of gravity of three particles, placed at the angular points of an equilateral triangle, and weighing 3, 3, and 4 oz. respectively.

6. What is the sole condition of the equilibrium of a body which is free to turn about a fixed axis?

A uniform straight lever is 6 ft. long and weighs 12 lb. If weights of 24 and 36 lb. are suspended from its extremities, find the position of the fulcrum on which it will balance.

7. Show that if a substance be weighed successively in the two scales of a balance with unequal arms its true weight is a mean proportional between the apparent weights.

8. What is meant by the *whole pressure* of a liquid on a surface? In what case is the whole pressure equal to the resultant pressure?

The water in a canal rises to the height of 10 ft. against a lock gate whose breadth is 20 ft.: find the whole pressure upon the gate.

9. Explain the method of determining the specific gravity of a liquid by means of the hydrostatic balance.

A quartz crystal, whose weight is 318 grains, loses 120 grains when weighed in water, and 96 grains when weighed in alcohol. When a piece of wood of 240 grains weight is attached to the crystal they weigh together 118 grains in water. Required the specific gravities of alcohol, of quartz, and of the wood.

10. Make diagrams of the *forcing-pump* and the *condensing-syringe*, and explain their action.

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

1. Explain the method of graduating a mercury thermometer according to the centigrade scale. Express the following Fahrenheit temperatures in the centigrade scale: 40° , 0° , 140° .

2. State the laws of fusion, and explain what is meant by the *latent heat* of fusion.

If 6 oz. of dry snow at 0° C. be melted in 15 oz. of water at 40° C., find the resulting temperature.

3. Define *thermal capacity* and *specific heat*.

If the density of iron is 7.6, and its specific heat 0.115, find the thermal capacity of unit volume. If 10 cubic centimetres of iron at 100° C. be immersed in 200 cubic centimetres of water at 9° C., find the resulting temperature.

4. Distinguish between the *conduction*, the *convection*, and the *radiation* of heat.

5. What is meant by a "musical interval"? Give an account of the "diatonic scale."

6. When an object is placed 1 ft. from a convex lens its image is formed on the other side of the lens at a distance of 2 ft. from it. Where will the image be formed when the object is placed 9 in. from the lens?

7. Describe, with the aid of a diagram, the arrangements which you would make for exhibiting on a screen the solar prismatic spectrum. Indicate on your diagram the order in which the colours follow one another in the spectrum.

8. Explain what is meant by "magnetic induction" and by "lines of magnetic force." State the elementary laws of magnetic force.

9. A plate of metal is placed over the disc of a gold-leaf electroscope at a small distance from it, and a glass rod electrified by rubbing with silk is held over the metal plate. Describe the electrical condition of the metal plate and the electroscope (1) when the plate is insulated, (2) when it is connected with the earth.

10. State the laws of electrolysis. Explain the arrangements which you would make for obtaining the products of the electrolysis of acidulated water.

11. A voltaic cell gives a certain current through an external resistance of 75 ohms, and when the external resistance is reduced to 35 ohms the current from the cell is doubled. What is the resistance of the cell?

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

1. Describe with equations the preparation of nitric acid and of ammonia. How can the percentage of nitric acid in a solution be ascertained?

2. What experimental evidence do you know for the formula H_2O ? Why would not HO or H_4O_2 equally well represent the molecule of water?

3. What weight of chlorate of potash will yield sufficient oxygen to burn 100 grams of marsh gas? What volume will the products of combustion occupy at 150° C. and 760 mm. pressure? ($K = 39$; $Cl = 35.5$; $O = 16$; $C = 12$; $H = 1$.)

4. State any laws that you know bearing on the behaviour of gases as regards (a) pressure, (b) temperature, (c) diffusion, (d) solution.