

CLASS D.—ELECTRICITY (Optional).

Time allowed: Three hours.

1. Describe fully the properties of a loadstone.
2. Describe the experiments that may be made to prove the earth to be a large magnet.
3. Give an account of magnetic induction; and describe some of the more striking experiments to illustrate the induction of soft iron.
4. Describe a gold-leaf electroscope, and state how, by means of it, you would determine the kind of electricity on a body.
5. State all the essentially different ways in which electricity may be produced.
6. Contrast the electricity produced by a galvanic battery with that produced by an electric machine.
7. Give a description of the construction and chemical action of a Daniell's cell, and state in what respects it is better than a Smee's cell.
8. Describe the mode by which a distant charge of gunpowder is fired by an electric current, and state the laws of the production of heat by the electric current.
9. Give a clear account of the construction of an electro-magnet; and describe some apparatus, such as an electric bell or engine, in which the electro-magnet is practically used.
10. Describe the chemical changes that ensue when a current of electricity is sent through a solution of sulphate of copper. State the laws of electrolysis.

CLASS D.—SOUND AND LIGHT (Optional).

Time allowed: Three hours.

1. A workman is at a distance driving a bar into rock; he is striking ten blows a minute; exactly as the hammer is seen to fall the sound of a blow is heard: at what several distances away may he be for this to happen? Can you suggest any means, merely by watching the man and noting the sound of the blows, of telling which of these distances is the true one?
2. Describe clearly the nature of a sound-wave, and explain how two waves may be made to interfere so as to destroy each other.
3. Give illustrations of resonance and sympathy of vibrations generally, and state where the principle is used in musical instruments.
4. What becomes of a beam of light when it falls obliquely on a plane piece of plate-glass?
5. Show by a diagram how an image is formed in a concave mirror.
6. Explain the formation of an image in a plane mirror, and show by a diagram how it is that you can see your whole reflection in a mirror half your height.
7. Draw a section through an opera-glass or any other telescope. Show how the image is formed in such a telescope.
8. A beam of white light is made up entirely of pure red and pure green; it is allowed to fall upon a prism: show by a diagram the course of the rays after passing the prism, and the appearance the light presents when it is allowed to fall upon a white wall.
9. Give a clear account of the origin of the black bands of the solar spectrum.
10. Describe the construction of an achromatic lens. If I look at a spot of light with an ordinary lens, what appearance will it present?

CLASS D.—HEAT (Optional).

Time allowed: Three hours.

1. What is meant by the coefficient of expansion? How has the coefficient of expansion of metals been ascertained? What is the coefficient of all perfect gases?
2. One pound of ice at 0°C ., ten pounds of water at 5°C ., and two pounds of steam at 100°C . are mixed: what will be the resultant temperature?
3. Describe fully all the physical changes, as regards both matter and energy, in the process of converting ice into steam.
4. Give an account of the action of any form of steam-engine with which you are acquainted. Make a detailed sketch of the valves for causing the steam to enter and leave the cylinder.
5. How many units of heat are equivalent to the work of lifting 5,000 lb. to a height of 500 feet? How has it been proved that quantities of heat and work may be expressed in terms of one another?
6. How may heat be converted into chemical energy, into electricity, and into mechanical work respectively?
7. Describe experiments to prove that radiant heat and light are the same, except as regards their wave-lengths.
8. Explain conduction and convection, and give examples of both phenomena.
9. Describe fully the formation of clouds.
10. What is meant by the term "specific heat"? State what you know of the laws of the specific heat of gases, and describe one method by which specific heats have been ascertained.

CLASS D.—BOTANY (Optional).

Time allowed: Three hours.

1. Describe a vegetable cell, and mention the chief cell-contents, classifying them according to chemical composition.
2. Describe as many kinds of inflorescence as you can.
3. Draw diagrams of flowers with hypogynous, perigynous, epigynous, and epipetalous stamens; and describe the differences in the flowers.