

9. Describe a thermo-electric pile and galvanometer. Do you know of any other apparatus for indicating temperature by means of electricity?

10. How would you make an experiment to show the phenomena of magnetic induction? Describe Gramme's ring dynamo.

CLASS D.—SOUND AND LIGHT (Optional).

*Time allowed: Three hours.*

1. How has the velocity of sound in glass and in hydrogen been determined? It is greater in both of these substances than in air: why?
2. Explain the production of beats. What is supposed to be their relation to discord and concord?
3. Explain how sound may be brought to a focus by refraction and reflection respectively.
4. What are the rates of overtones of strings, and of open and closed organ-pipes respectively? Upon what does the "character" of a sound depend?
5. Describe two methods of determining the velocity of light dependent upon astronomical, and two dependent upon terrestrial, observations.
6. In what several ways may light be analysed?
7. Describe Eelmholtz's and Clerk Maxwell's apparatus for showing combinations of colours. Why do yellow and blue pigments produce green when mixed?
8. What are the various modes of producing interference of light? Describe and explain one in detail.
9. Give a general account of spectrum analysis. How may the black lines in the solar spectrum be imitated?
10. In what several ways may light be polarized? Explain the depolarization of light when a piece of selenite is placed between crossed Nicol's prisms.

CLASS D.—HEAT (Optional).

*Time allowed: Three hours.*

1. Describe Roy and Ramsden's method for determining the coefficient of expansion of metals. How are the cubic, superficial, and linear coefficients of substances related to one another?
2. State some of the advantages and disadvantages arising from expansion that occur in the practice of the arts. Explain how expansion is compensated for in timekeepers, and make a sketch of a gridiron pendulum.
3. Define specific heat. What are its laws? How is specific heat usually determined?
4. In what various ways does heat diffuse itself? How has the absolute coefficient of conductivity been determined?
5. Describe all the different ways in which clouds are formed. How is snow formed?
6. How has the tension of aqueous vapour been determined? State approximately the tension at 0° C., at 100° C., and at 200° C.
7. Show by a diagram the distribution of energy in the solar spectrum. How is this energy modified by passing the ray through iodine, rock salt, and alum respectively?
8. Classify the varieties of energy. Give illustrations of the transformation of the energy of heat into mechanical work, into chemical affinity, and into electricity respectively.
9. What is a unit of heat? What is the mechanical equivalent of heat, and how has it been determined? If a ball of iron were to fall two miles, and all the energy developed were spent in heating it, what would be the increase in temperature?
10. What are the latent heats of steam and of water? How have they been determined? What would be the resultant temperature if 5lb. of steam at 100° C. and 30lb. of ice at 0° C. were mixed?

CLASS D.—BOTANY (Optional).

*Time allowed: Three hours.*

1. What are fibro-vascular bundles? How are they arranged in the stem and leaves of Monocotyledons and Dicotyledons respectively?
2. Describe the principal forms of inflorescence, illustrating your descriptions with diagrams.
3. Draw diagrams of an apocarpous ovary; of a syncarpous trilocular ovary; and of a syncarpous unilocular ovary formed of three carpels.
4. What is the difference between a seed and a fruit? and what are the different parts found in a grain of wheat and in a pea?
5. Explain the differences between simple fruits, spurious fruits, and aggregate fruits, giving examples of each kind.
6. Describe the plant in a young pea, a young cabbage (or mustard), and young wheat (or grass), when the leaves first appear above the ground.
7. Describe fully the flower in any three plants that you have studied.
8. Give the characteristics of any three of the following orders: Compositæ, Onagraricæ, Cruciferæ, Liliacæ, Leguminosæ, Scrophularinæ.
9. What is meant by insect fertilisation? Describe some flower adapted for this.
10. Explain why the leaves of a plant are coloured green, while the flowers are almost always of some other colour.
11. Describe the process of transpiration, and contrast it with respiration in plants.
12. What constitutes the food of plants, and how do they absorb it?