

2. How can the real and apparent coefficient of expansion of a liquid be determined?
3. Describe two methods whereby the temperature of maximum density of water can be ascertained.
4. Heat is said to be a form of energy: give any evidence you can in support of this statement.
5. 100 c.cm. of steam at 100° C. and 760 mm. pressure, contained in a cylinder with a moveable piston, is (a) compressed to one-half its volume (b) expanded to twice its volume by the movement of the piston: state clearly what other physical changes will accompany the changes in volume.
6. A ball of brass weighing 75 grains, and at a temperature of 15° C., was surrounded by steam at 100° until the temperature became constant, when it was found that 1.1 grams of water had condensed on the ball: if the latent heat of vaporisation of water at 100° be 537, what value does this experiment give for the specific heat of brass?
7. Describe Bunsen's ice calorimeter. Explain how it is got ready for use, and how it is used. What advantages or disadvantages has Bunsen's method over the method of mixtures?
8. How would you show that benzine has a lower specific gravity but a higher vapour-pressure than kerosene? How would you propose to measure the vapour-pressure of kerosene at 100° C.?

*No. 45.—Magnetism and Electricity.—For Civil Service Junior.*

*Time allowed: Three hours. [Illustrate your answers, where possible, by diagrams.]*

1. What do you understand by the magnetic meridian at a given place? How can the plane of the magnetic meridian be accurately determined and recorded?
2. By what experiments would you ascertain whether the poles of two magnets were of the same strength?
3. How could you magnetize a steel ring in such a way that it would show neither north nor south poles? Show by a diagram the magnetic state of the two pieces if the ring were broken in halves.
4. Describe the construction of the gold-leaf electroscope. How is the instrument used to test the state of electrification of an insulated conductor?
5. Explain the production of electricity by the plate electrical machine and by the electro-phorus.
6. Make a careful diagram of a Daniell cell, indicating by arrows the direction of the current without and within the cell. What changes occur in the cell when a current is passing?
7. Define the terms "ampère," "ohm," and "volt"; and explain how the ampèreage of two currents can be compared.
8. What conditions determine the heating effect of an electric current? A current flows in series through a fine platinum wire surrounded by cold water and through a strong solution of copper sulphate: if the strength of the current be doubled, what will be the effect upon (1) the rate of evolution of heat from the wire, (2) the rate of deposition of copper from the copper sulphate?

*No. 46.—Magnetism and Electricity.—For Class D.*

*Time allowed: Three hours. [Illustrate your answers, where possible, with diagrams.]*

1. Describe any experiments which you have made with magnets.
2. A magnetic needle is suspended in the magnetic meridian in such a manner that it can swing only in a vertical plane: if the stand upon which the needle is suspended is slowly turned horizontally through an angle of 180°, trace and explain the changes in the position taken up by the needle.
3. How can it be shown that there are two kinds of electrification? How would you attempt to show that the production of one kind of frictional electricity involves the production of an equal quantity of the other kind?
4. Explain the terms "free" and "bound" electricity, and describe any of Faraday's experiments upon free and bound charges.
5. What do you understand by electrical potential? How would you ascertain (1) whether the potential, (2) whether the density of the charge were the same at all points upon an insulated egg-shaped conductor? What results would you expect to find?
6. Describe any effects which may be observed in the neighbourhood of a wire through which a current is flowing. Which effects are directly proportional to the strength of the current?
7. If you were given two bichromate cells, on what considerations would you decide whether to use them in series or in parallel?
8. Explain the construction of an incandescent lamp. If you were able to increase gradually but indefinitely the voltage between the terminals of such a lamp, what effects would you expect to notice?

*No. 47.—Magnetism and Electricity.—For Class C and for Civil Service Senior.*

*Time allowed: Three hours.*

[Atomic weights: H = 1, O = 16, S = 32, Cu = 63, Zn = 65.]

1. What do you understand by "the intensity of a magnetic field" at a point in it? How would you plot a chart showing at all points the direction and intensity of the horizontal field passing through the centre of a vertical circular coil of wire through which a uniform current is flowing?