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Department of Education: Technical Instruction Branch

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COURSES IN APPLIED CHEMISTRY.

(39.)

AN ROINN OIDEACHAIS.
(Department of Education.)

BRAINSE AN CHEÁRD-OIDEACHAIS.
(Technical Instruction Branch.)

TECHNICAL SCHOOL EXAMINATIONS.
1933.

ELEMENTARY PHYSICS.
(First Year.)

Wednesday, May 3rd—7 to 10 p.m.

Examiner—PROFESSOR FELIX E. HACKETT, M.A., M.SC., PH.D.

Co-Examiner—E. P. BARRETT, ESQ., B.A., B.SC.

GENERAL INSTRUCTIONS.

You are carefully to enter on the Answer Book and Envelope supplied your Examination Number and the subject of examination, but you are not to write your name on either. No credit will be given for any Answer Book upon which your name is written, or upon which your Examination Number is not written.

You must not have with you any book, notes, or scribbling-paper.

You are not allowed to write or make any marks upon your paper of questions.

You must not, under any circumstances whatever, speak to or communicate with another candidate ; and no explanation of the subject of the examination may be asked for or given.

You must remain seated until your Answer Book has been taken up, and then leave the examination-room quietly. You will not be permitted to leave before the expiration of twenty minutes from the beginning of the examination, and will not be re-admitted after having once left the room.

If you break any of these rules, or use any unfair means, you are liable to be dismissed from the examination, and your examination may be cancelled by the Department.

Three hours are allowed for this paper. Answer Books, unless previously given up, will be collected at 10 *p.m.*

INSTRUCTIONS.

Read the General Instructions on page 1.

(*a*) The same number of marks is allotted for each question.

(*b*) Answers must be written in ink; sketches may be made in pencil.

(*c*) Write the number of the question distinctly, in the margin of your paper, before the answer.

(*d*) Not more than *six* questions may be attempted, of which not *more* than *three* may be selected from Section A, and not *more* than *three* from Section B.

NOTE.—Books of logarithmic and trigonometrical tables (four places) are provided.

SECTION A.

(*Not more than three questions may be taken from this Section.*)

1. Define specific gravity. A piece of metal weighs 59·3 grams in air, 53·7 grams in water and 54·5 grams in turpentine. Calculate the specific gravity of the metal and of the turpentine from these observations.

2. How is a mercury barometer set up? A bubble of air is allowed to ascend into the Torricellian vacuum at the top of a barometer tube, causing the mercury column to fall from a height of 76·5 cm. to 65·4 cm. The volume occupied by the air at the top of the tube is 1·54 c.c. Find the volume of the bubble at atmospheric pressure.

3. Describe an experiment to demonstrate the expansion of metals when heated. Explain how this property can be utilised in the construction of a metallic thermometer *or* give some instances where the expansion of metals must be allowed for.

4. Distinguish between "temperature" and "quantity of heat." Give an example from common speech of the confusion between the notion of heat and the notion of temperature. Mention any simple experiment that would help to make the distinction clear.

5. Steam is passed into a calorimeter weighing 25·68 grams and containing 107·2 grams of cold water at 14·4°C. The final temperature of the calorimeter and its contents is 29·6° C. The weight of the calorimeter *and its contents* is now 135·62 grams. Taking the water equivalent of the calorimeter as 2·43 calculate the latent heat of steam.

State the precautions which should be taken in carrying out this experiment.

6. What is meant by saturated vapour pressure? How may it be demonstrated that the boiling-point depends on the external pressure and that the saturated vapour pressure at the boiling-point is equal to the external pressure?

SECTION B.

(*Not more than three questions may be taken from this Section.*)

7. What apparatus would you use to study the reflection and refraction of light? Describe how you would verify the laws of reflection.

8. Describe some experiments on the magnetic effect of currents. Explain how this effect is applied to the measurement of current strength in ammeters or galvanometers.

9. Give some account of the production of heat in a conductor by an electric current.

An electric lamp is immersed in a liquid in a calorimeter, the total water equivalent of the latter and its contents being 1,000 grams. On connecting the lamp to the electric mains, it is found that a direct current of 0·3 ampere flows through it and the temperature of the calorimeter and its contents rise at the rate of 1°C. in 2 minutes and 20 seconds. Express the rate of generation in Joules per second and obtain the voltage applied to the lamp.

The mechanical equivalent of heat = 4·2 Joules per calorie.

10. The hydrogen in the electrolysis of water was collected separately in a graduated tube. At the end of five minutes 15 c.c. of hydrogen were evolved and the water in the tube was 10 cm. above the level outside. The temperature was 18°C. and the barometric pressure 75·8 cm. Ignoring the moisture in the gas, calculate the weight of hydrogen evolved. The weight of 1 c.c. of hydrogen at 0°C. and 760 mm. of mercury is 0·0000898 gram. Obtain the electrochemical equivalent of hydrogen, given that the current through the voltameter was 0·4 ampere. Density of mercury = 13·56 grams per c.c.

11. You are required to observe the potential difference in volts between the ends of a metre-length of fine iron wire kept at a constant temperature for different currents from 0·1 to 3 amperes. Sketch the circuit you would use and detail the apparatus you would require and the method of taking the observations. What law can you verify by such an experiment? State the way in which you would use your observations to do so.

12. Describe some form of secondary cell. Explain, in a general way, the processes which take place in the charge and discharge of the cell.