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Mathematics, Mechanics and Drawing (1st Year): Technical School Examinations 1934

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COURSE IN ELECTRICAL ENGINEERING.

(50)

AN ROINN OIDEACHAIS.
(Department of Education.)

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

TECHNICAL SCHOOL EXAMINATIONS.
1934.

MATHEMATICS, MECHANICS AND DRAWING.
(First Year.)

Tuesday, May 15th—7 to 10 p.m.

Examiner—R. G. ALLEN, ESQ., B.SC., A.R.C.SC.I., M.I.E.E.
Co-Examiner—PEADAR A. MACCIONNAITH, M.SC., A.C.SC.I.

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 working of the questions and the answers must be in *ink*.

(*b*) Diagrams and drawings must be made in *pencil*.

(*c*) Full credit cannot be obtained for any question unless all the calculations are shown clearly, and construction-lines definitely indicated.

Where calculations are made with the aid of the slide-rule a note should be made in the margin, thus—(S.R.).

(*d*) *Seven* questions only may be attempted, Question 11 and *six* others, of which not more than *four* may be taken from Section A, and *two* from Section B. Equal values are assigned to the questions.

(*e*) Write the number of the question before the answer.

NOTE.—You are expected to make neat and correct diagrams of reasonable size. You may use a slide-rule and drawing instruments.

SECTION A.

(*Not more than four of the seven questions you may attempt should be taken from this section.*)

1. An electric heater which has a resistance of R ohms, is supplied from E volt mains. Estimate the value of the input, namely $\frac{E^2}{R}$ watts, to the heater when

(*a*) E = 220 and (*b*) E = 200 volts ; R being supposed of constant value 4·26 ohms.

2. The filament of an electric lamp has a diameter of 0·0025 centimetre and a length of 110 centimetres. Find the surface area of the filament in square millimetres. If the candle power of the lamp is 50, estimate the candle power per square millimetre of the surface.

3. A sample of copper wire 38 inches long weighs 0·08 pound. Find the diameter of the wire assuming that a cubic inch of copper weighs 0·32 pound.

4. A motor takes an average current of 45 amperes at 440 volts for the working period of 48 hours per week. If the cost of power is 1·5 pence per kilowatt-hour, find the cost of running the motor for 50 weeks.

5. The candle power of a lamp rated at 220 volts is 150, but when the voltage is lowered to 200, the candle power falls to 100. Calculate the percentage fall in voltage and in candle power. If the power per candle-power taken by the lamp at 220 volts is 0·6 watt, estimate the current passing through the filament.

6. The sine of an angle is 0·8 and its cosine is 0·6. What is the value of its tangent ? A voltmeter indicates 40 sin A volts. Graph its indications against simple values of A ranging from 0 to 90 degrees.

SECTION B.

(*Not more than two of the seven questions you may attempt should be taken from this section.*)

7. Explain what is meant by the parallelogram of forces. Find the value of the resultant of two outward forces acting from a common point, one 60 and the other of 40 pounds weight, when the angle between them is (*a*) 0, (*b*) 60°, and (*c*) 90°.

8. Three horizontal straight lines meet at a point, and the clockwise angle between the first and the second is 90, and between the second and third is 120 degrees. Supposing a force of 24 pounds weight acts outwardly along each line, find by resolving forces, the value and direction of their resultant.

9. ABCD is a straight beam supported at B and C, and each of the lengths of AB, BC, and CD is equal to 3 feet. Weights of 50, 80, and 60 pounds are placed on the beam at the respective points A, the middle of BC, and at D. Neglecting the weight of the beam, find the pressure on each support.

10. Show that the value of the moment of a *couple* about any point in its plane is constant. If the value of each force is 40 pounds, and the arm of the couple is 5 inches, find the value of the moment of the couple. Give two illustrations of the action of a couple in electrical or mechanical apparatus.

SECTION C.

11. Four substations, A, B. C, and D, taken in a clockwise direction lie on a circle, and are supplied from a power station at O. The angles A O B, B O C, and C O D, are respectively 70, 80, and 90 degrees ; also the respective lengths of O A, O B, and O C, are 500, 700, and 600 yards. Construct a diagram to scale showing the positions of the five stations and give the value of the distance O D.