

1933

Mechanics and Electricity (3rd Year): Technical School Examinations 1933

Department of Education: Technical Instruction Branch

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9. Explain how and why the state of charge of a lead-acid battery may be tested by means of (a) a hydrometer, (b) a voltmeter.

10. With reference to a rotating coil H.T. magneto discuss the following points:—

- (a) the normal sparking position of the armature relative to the magnets.
- (b) the return path of the secondary current from "earth" to the armature.
- (c) the need for and position of the safety gap.
- (d) the correct position of the distributor arm relative to the contact points' opening, and how this is ensured.
- (e) the method employed for "advance" and "retard."

11. Contrast and explain the difference in voltage behaviour of the series wound and the shunt wound dynamo when run at constant speed under varying current loads.

12. Describe with the aid of sketches one of the following devices:—

- (a) an electromagnetic head lamp "dipper" -

or

- (b) a "series-parallel" switch which dims the head lamps by changing their connections from "parallel" to "series."

13. Ten similar 12 volt batteries are joined in series and charged at the rate of 10 amperes from a 220 volt d.c. house supply. What is the approximate value of the resistance to be included in the circuit and the cost per battery of charging at this rate for 6 hours if Electrical energy costs 6d. per B.o.T. unit?

Repeat the calculations for the case where one battery only is being charged.

COURSE IN MOTOR CAR ENGINEERING.

(74.)

AN ROINN OIDEACHAIS.
(Department of Education.)

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

TECHNICAL SCHOOL EXAMINATIONS.
1933.

MECHANICS AND ELECTRICITY.
(Third Year.)

Tuesday, May 2nd—7 to 10 p.m.

Examiner—M. KEADY, ESQ., B.S.C. (Eng.), A.R.C.S.C.I.

Co-Examiner—J. P. HACKETT, ESQ., B.E., A.R.C.S.C.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, on upon which your Examination Number is not written.

You must not have with you any book, notes, or scribbling paper, except the book of logarithms supplied to you.

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) 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. Books of logarithmic and trigonometrical tables (four places) are provided. You may use a slide-rule and drawing instruments.

SECTION A.

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

1. If r = length of crank and l = length of connecting rod the formula

$$x = r \cos \alpha - \frac{r^2}{4l} (1 - \cos 2\alpha)$$

gives the displacement x of a piston from its mid position when the crank has turned through an angle α from its inner dead centre position.

Calculate the values of x for every 30° of crank rotation during one stroke (i.e., from $\alpha=0^\circ$ to $\alpha=180^\circ$)—when $r=4''$ and $l=6''$.

Plot the piston displacement curve (x and α).

2. Explain what is meant by the statement "1 B.Th.U. is equivalent to 778 ft. lbs."

Assuming this relationship what H.P. is theoretically available from the combustion of 1 gallon (7 lbs.) of petrol per hour?

(1 lb. of petrol liberates on combustion 19,800 B.Th.U's.)

3. What is meant by "Kinetic Energy?" From the point of view of energy explain the function of the fly-wheel on a single cylinder engine.

What extra energy is stored by a flywheel weighing 64 lbs. and having an effective radius of 6" when its speed is increased from 1200 r.p.m. to 1800 r.p.m.?

4. A steel bar 4' 2" long and 1" diameter, carries a tensile load of $6\frac{1}{2}$ tons. Calculate the Stress and also the stretch if the Modulus of Elasticity is 13,000 tons per square inch.

5. Write down the kinds of stress or stresses to which the following engine parts are subjected during the working stroke at (a) top dead centre, (b) $\frac{1}{4}$ stroke, (c) $\frac{3}{4}$ stroke, (d) bottom dead centre:—Cylinder walls, gudgeon pin, connecting rod, crank pin, crank web, and crank shaft.

Illustrate your answer with sketches.

6. Explain what you understand by "torque."

An engine develops 20 B.H.P. at a speed of 1,500 r.p.m. Neglecting friction calculate the rear axle torque on low gear at this engine speed if the total gear reduction is 10 to 1.

7. Due to rotating engine parts the following forces are set up in one plane:—180 lbs., 120 lbs., 80 lbs., and 210 lbs. The forces act radially outwards and reckoning anti-clockwise from the 180 lbs. force the angular directions of the others are:—120 lbs. force -30° ; 80 lbs. force -150° ; 210 lbs. force -240° .

By means of the polygon of forces—find whether these forces are out of balance, and if so, find the size and direction of the single force required to balance them.

SECTION B.

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

8. Describe with the aid of sketches how you would examine how the voltage of a separately excited dynamo depends on (a) the speed (b) the field current. State the results you would expect to obtain and indicate generally how the principles found may be used for the "constant voltage" regulation of a car dynamo.