1933

Applied Mechanics and Heat Engines (4th Year): Technical School Examinations 1933

Department of Education: Technical Instruction Branch

COURSES IN MECHANICAL ENGINEERING.

AN ROINN OIDEACHAIS.
(Department of Education.)

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

TECHNICAL SCHOOL EXAMINATIONS.
1933.

APPLIED MECHANICS AND HEAT ENGINES.
(Fourth Year.)

Monday, May 8th—7 p.m. to 10 p.m.

Examiner—P. CORMACK, ESQ., F.R.C.SC.I., M.R.I.A.
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.*

Read the General Instructions on page 1.

(*a*) *Seven* questions only may be attempted, *not* more than *Four* being taken from either Section A or Section B.

(*b*) Equal values are attached to the questions.

(*c*) Answers must be written in *ink*; diagrams may be drawn in *pencil*.

(*d*) Write the number of the question distinctly in the margin of the paper before the answer.

(*e*) Slide-rules and drawing instruments, may be used.

(*f*) Abridged Callendar Steam Tables (Centigrade units) may be used.

Section A.

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

1. The indicator diagram from a steam engine, $12\frac{1}{2}''$ bore, $15''$ stroke, is shown in Fig. 1. The connecting rod is 3 ft. long. Find the turning moment on the crankshaft when the crank angle is 40° from the inner dead centre. Calculate a suitable size for a shaft to transmit this torque. Allowable stress 8,000 lbs. per sq. inch.

2. Figure 2 shows the erection of an electric cable weighing 900 kilograms per span between posts. The tension in the cable where it runs over the pulleys is 950 kilograms. Calculate the sag S of the cable. (You may assume $S = \frac{1}{4}d \tan \theta$) The distance between the posts is 200 metres.

3. What is the immediate cause of the disruption of a flywheel? Show that in a rotating rim the centrifugal tension is equal to the centrifugal force of the mass of a radius-length of the rim.

4. Figure 4 is a scale drawing of a loaded governor. The radius in which the balls run is 7 inches. Find the force F necessary to maintain the configuration shown and hence determine the speed of the governor. The weight of each ball is 20 lbs. and the load is 80 lbs.

5. The suspension of a three-phase electric current transmission is shown in Fig. 5, to scale. The load at each of the points A, B and C is 90 kilograms, as shown. Find the load on the pin D in magnitude and direction and also on the pin E due to the load at A only. Assume the cross bars pin jointed at A.

Similarly find the forces on the pins D and E due to the load at C and again due to the load at B. Hence obtain the total force on the pins D and E respectively.

6. In testing the power of an engine by a transmission dynamometer, Fig. 6, the thrust P was found to be 12 lbs. Find the brake horsepower. Speed of B 300 r.p.m.; diameter of B 40 inches; centres of C and D 36 inches apart; arm EF 30 inches long. The arm CD pivots about F, which is a fixed centre.

Section B.

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

7. The explosive mixture in an oil engine consists of air and oil in the proportion of 30 lbs. of air to 1 lb. of oil. The calorific value of the oil is 11,100 C.H.U. per lb. Find the rise in temperature when the explosion occurs at

(*a*) constant volume,

(*b*) constant pressure.

The specific heat of the products of combustion at constant volume is 0·16 and at constant pressure 0·24.

8. Describe in detail the operations necessary in the starting and the stopping of a condensing steam engine. Give reasons for the several operations.

9. A heat accumulator consists of a closed cylindrical water tank, 14 ft. diameter and 116 ft. long. The water is heated by blowing in saturated steam at 200 lbs per sq. inch. When fully charged the accumulator delivers steam initially at 200 lbs per sq. inch but falling eventually to 40 lbs per sq. inch. Calculate approximately the horsepower hours output of the accumulator, the steam being used in turbines having a thermal efficiency of 25% with a condenser pressure of 1 lb. per sq. inch.

10. You are required to conduct a trial on a pulverised fuel boiler to compare its performance with that of a stoker fired boiler. State the measurements required and describe how they are to be determined.

11. There was 0·11 lb. of steam in the cylinder during the expansion shown on the diagram, Fig. 1. Find the dryness fraction at the points A and B. Did the steam take heat from or give heat to the cylinder walls during this part of the stroke?

12. In a compound impulse turbine the first stage is a two-row Curtis wheel which brings the pressure down from 175 lbs. to 35 lbs. and the remainder of the expansion to condenser pressure is done in six Rateau stages. Make a sketch of the arrangement showing the blades and nozzles and explain with diagrams the action taking place in the velocity-compounded Curtis wheel and in the pressure-compounded Rateau stages.

APPLIED MECHANICS AND HEAT ENGINES (FOURTH YEAR).

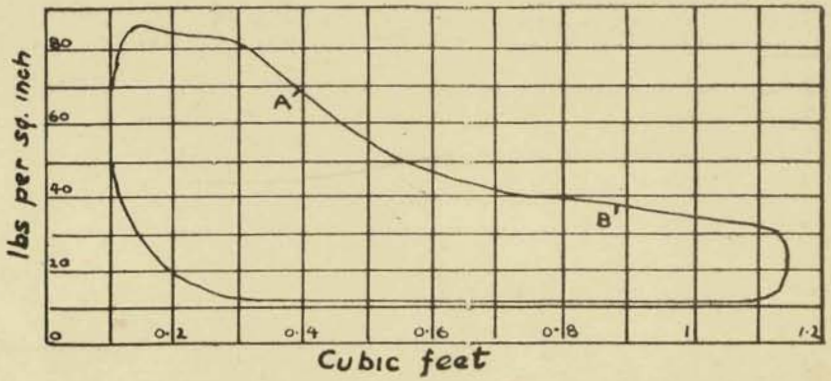

Fig. 1

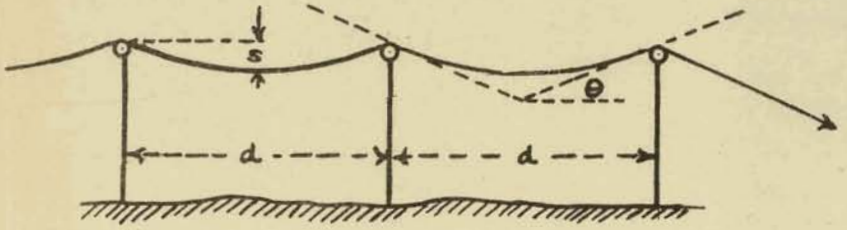

Fig. 2

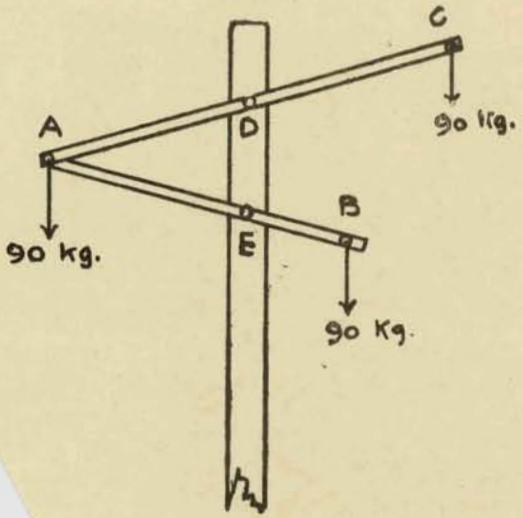

Fig. 5

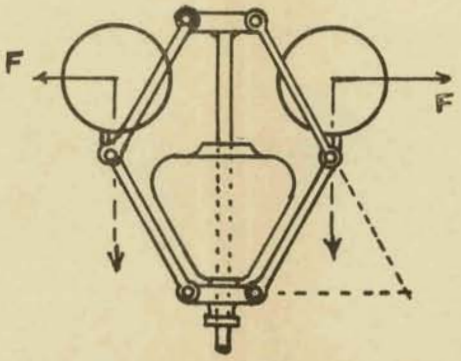

Fig. 4

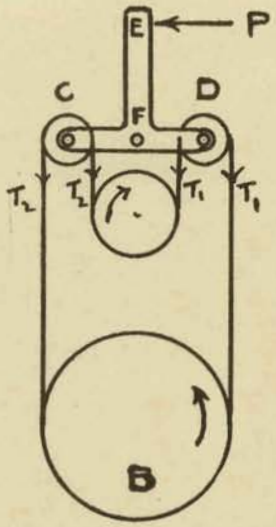

Fig. 6