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COURSES IN MECHANICAL ENGINEERING.

AN ROINN OIDEACHAIS.
(Department of Education.)

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

TECHNICAL SCHOOL EXAMINATIONS.
1933.

APPLIED MECHANICS.
(Third Year.)

Wednesday, May 10th—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 books, 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 in your place 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 commencement 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*) You may *not* attempt more than *seven* questions in all.

(*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 your paper before the answer.

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

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1. In Fig. 1, ABC is a scale drawing of a belt passing under a jockey pulley D which weighs 50 lbs. The pulley axle turns in the end D of a radius link DE which can swing about a fixed pivot at E.

Denoting the tension in the belt by T lbs., state all the forces acting on the jockey pulley. From your own measurements on the diagram find the moments of these forces about E and hence determine the belt tension T.

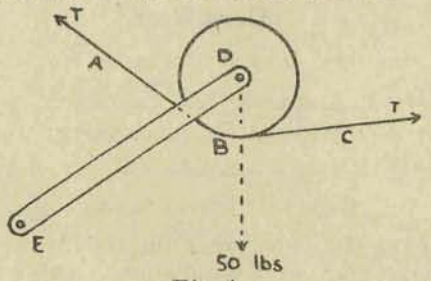

Fig. 1.

2. An experimental model of a Porter Governor is shown to scale and the system of forces acting on it is indicated in Fig. 2. Find the tension in the strings BD, DC, AC and AB, and the force F in the horizontal strings pulling B and C apart.

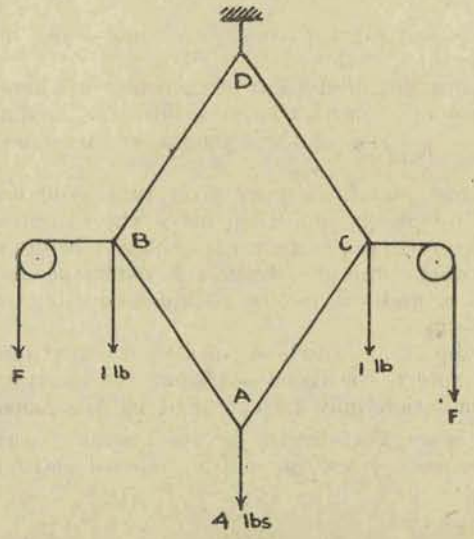

Fig. 2.

3. Which has the greater acceleration : An automobile getting under way at 2.5 miles per hour per second or an automobile stopping from a speed of 20 miles per hour in a distance of 20 feet? Calculate the tractive force required in each case if the automobile weighs 3,000 lbs.

4. The diameter of a cylinder is 54 inches. The piston working in this cylinder has a spring ring 6 inches wide and the pressure between it and the cylinder is 3 lbs. per sq. inch. Find the piston friction taking the coefficient of friction ·05.

5. The buffers of a waggon are spring loaded. A compression of 5 inches is provided for and when fully compressed each buffer pushes with a force of 500 lbs. The waggon fully loaded weighs 13 tons. Find the greatest speed at which the waggon may strike a fixed stop without exceeding the compression allowed.

6. Find the stresses in the members of the cantilever frame shown in Fig. 6, which is drawn to scale.

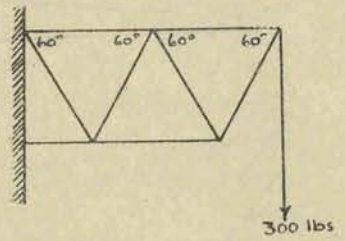

Fig. 6.

7. A crankshaft $12\frac{1}{2}''$ diameter weighs 12 tons and it is also pressed against the bearing by 36 tons acting horizontally. Find the horsepower lost in friction at 30 revs. per min. Coefficient of friction ·06.

8. The railway sleeper, Fig. 8, is shown supported at the ends A and B. Find the greatest bending moment on the sleeper when the load on each rail is 3 tons.

After some time the packing at A and B gets beaten down and then it is supported in the middle at C only. What is now the greatest bending moment on the sleeper? Why is this latter condition objectionable?

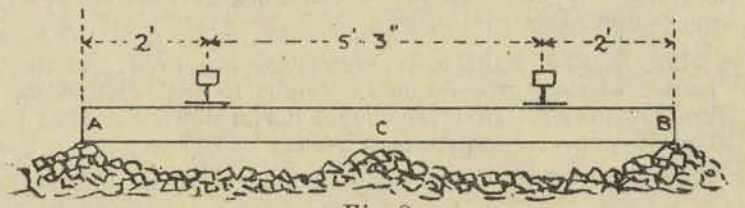

Fig. 8.

9. A water tank 120 feet above ground level is supplied by a hand force pump at ground level. The pump plunger is 3″ diameter and it is operated by a handle which forms a lever having a long arm of 30 inches and a short arm of 5 inches. Find the force at the handle necessary to work the pump.

10. Fig. 10 shows an insulator supporting 200 metres of electric cable. The cable is 50 sq.mm. cross section and made of copper weighing 9 grams per c.c. Find the weight of cable supported. The wind acting at right angles to the line blows the cable over so that the insulator (which is free to pivot about O) is deflected from the vertical through the angle AOB. Determine the wind pressure on the cable. You may neglect the weight of the insulator.

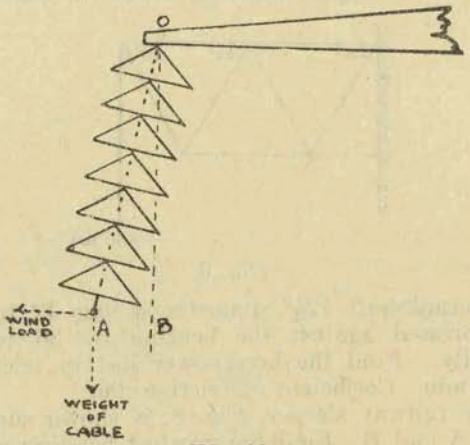

Fig. 10.

11. A quarry service waggon runs at 10 miles per hour. Portions of the track are sharply curved. Find the least radius of the curve so that the centrifugal force on the stone slabs in the waggon may not exceed one quarter of their weight.

12. In what units is kinetic energy measured? If the loaded waggon in question 11 weighs 15 cwt. what is its kinetic energy? How far should it run down a grade of 1 in 10 to acquire this kinetic energy?