1933

Mathematics and Geometry (1st Year): Technical School Examinations 1933

Department of Education: Technical Instruction Branch

COURSES IN MECHANICAL ENGINEERING.

AN ROINN OIDEACHAIS.
(Department of Education.)
BRAINSE AN CHEÁRD-OIDEACHAIS.
(Technical Instruction Branch.)

TECHNICAL SCHOOL EXAMINATIONS.
1933.

MATHEMATICS AND GEOMETRY.
(First Year.)

Monday, May 29th—7 *to* 10 *p.m.*

Examiner—F. W. WARWICK, ESQ., B.A., B.E., A.R.C.SC.I.
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 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*) 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*) Answers must be written in *ink*; diagrams may be drawn in *pencil*.

(*e*) Write the number of the question distinctly in the margin of the paper 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 four of the seven questions you may attempt may be taken from this section*).

1. The horse-power P which a rope d inches diameter will transmit when travelling at s feet per minute is given by the formula.

$$P = \frac{Sd^2}{33000}\left(160 - \frac{S^2}{425000}\right)$$

Calculate P when $s = 4000$ and $d = 1\frac{1}{2}$.

2. The crippling load, P, for a cylindrical compression member is proportional directly to the modulus of elasticity, E, directly to the fourth power of the diameter, *d*, and inversely to the square of the length, *l*.

Write down an equation showing the value of P in terms of the other variables and a constant, *k*, and find the value of P when E = 13,000, $d = 2$, $l = 80$ and $k = 0{\cdot}5$.

3. Calculate the weight of a steel bar ten feet long whose cross section is a regular hexagon, the length of whose side is $\frac{5}{8}$ inch. Steel weighs 490 lbs. per cubic foot.

4. A cylindrical drum 3 feet deep has a capacity of 15 cubic feet. Calculate its diameter in feet to three significant figures without using tables.

5. The axis thickness, *t* inches, of a screw propeller is given by the formula

$$2 \log t = 3 \log d + \log E - \log n - \log b.$$

Calculate *t* when $d = 10{\cdot}5$, $n = 3$, $E = 2{\cdot}04$ and $b = 25$.

6. Given two sides *a* and *b* of a triangle and the contained angle C the third side *c* can be obtained from the formula

$$c^2 = a^2 + b^2 - 2ab \text{ Cos } C$$

Transpose the equation to show the value of Cos C in terms of the three sides of the triangle.

A crane post is 8 feet high, the jib 10 feet long and the tie 9 feet long. Find the angle between the jib and tie.

7. Calculate the weight of the cast iron bracket, whose dimensions are shown at Figure 7, if the density of the metal is 0·28 lbs. per cubic inch.

SECTION B.

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

8. The weights, *w* lbs. per foot, of round steel bars, *d* inches diameter are given in the following table:—

d:	$\frac{3}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
w:	1·50	6·01	10·7	16·8	24·1

Plot a graph from which the weights per foot of all sizes up to three inches diameter may be obtained and write down the values for bars $1\frac{3}{8}''$ and $2\frac{7}{8}''$ diameter, respectively.

9. The co-ordinates of three points A, B and C are 0·5, 0·3; 1·7, 0·8 and 1·0, 1·9 respectively. Plot these points to a scale twice full size. Obtain from your diagram the size of the angle BAC and the tangent of the angle ABC.

10. Two pulleys each three feet diameter, whose centres are ten feet apart, are connected by a crossed belt. Draw an accurate diagram of the arrangement to a scale of one inch = two feet. Measure the angle of lap of the belt.

11. The outline of an oval flange is constructed of four tangential arcs of circles. The length of the major axis is 3 inches and of the minor axis $1\frac{3}{8}$ inches. The circular arcs at the extremity of the major axis have each a radius of $\frac{3}{8}$ inch.

Draw the flange full size, and determine the radius of the other pair of circular arcs. The centres of the circles and construction lines should be clearly shown.

12. The front and end elevation and an incomplete plan of two cylinders intersecting in the manner of a fan casing are shown to scale at Fig. 12.

Complete the plan by drawing the curve of intersection.

13. A framework, constructed of four links AB, BC, CD and DA each 2 inches long freely jointed to each other, is pivoted at A (Fig. 13).

A crank SP one inch long, rotating round S, has its crank pin connected by two links PB and PD each $1\frac{1}{4}$ inches long freely jointed to the frame at B and D. The fixed distance SA is $1\frac{3}{4}$ inches.

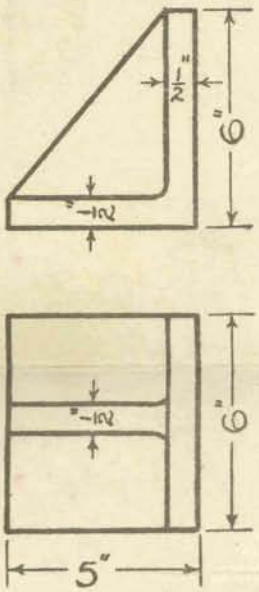
Draw the path traced out by C while the crank makes a complete revolution.

14. A sketch elevation and a plan of a machine fitting are shown at Fig. 14 fully dimensioned. Draw the elevation viewed in the direction of the arrow.

Courses in Mechanical Engineering, 1933

Mathematics & Geometry (First Year)

Note : The Diagrams are numbered to correspond with the questions to which they refer.



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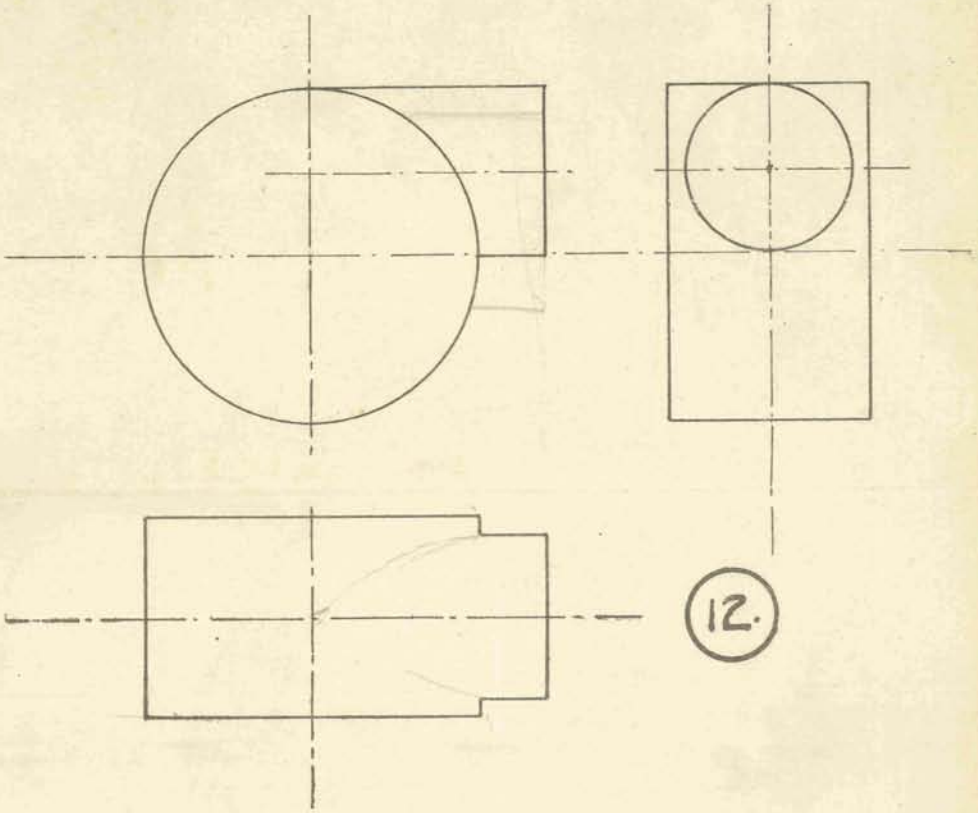

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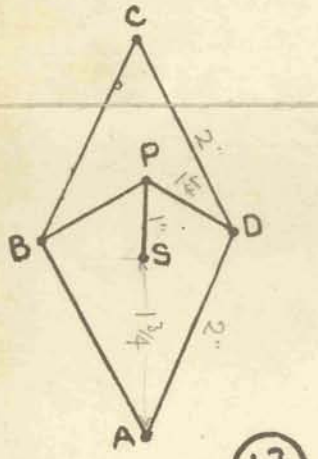

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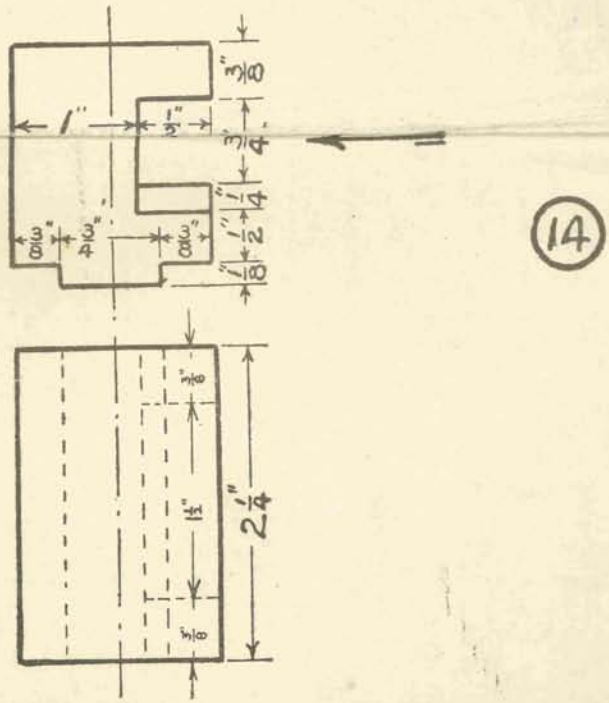

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