If 51° 35′ be subtracted from 90, and the remainder doubled as above, the length of the longest day will be found to be 76 days 20 hours.

PART III.

MENSURATION.

73. To find the superficial contents of a board or plank.

1st.—When the breadth is less than 12 inches.

RULE.—Set 12 on I to breadth in inches on A or B, then length in feet on I will show content in feet on A or B.

Ex.—How many square feet are there in a board 24 feet long and 9 inches wide?

Set 12 on F to 9 on B, or 120 on F to 90 on B, then 24 on F will show 18 feet on B.

Ex. 2.—Required the area of a deal 18 feet long and 10 inches broad.

12 on F : 10 on A : : 18 on F : 15 on A = the answer.

12 on F : 10 on B : : 18 on F : 15 on B = answer.

Ex. 3.—In a plank 7 ft. 6 in. long and 8 in. broad, how many square feet?

12 on F : 8 on B : : 7½ or 7.5 on F : 5 on B = the content required.

2d.—When the breadth is greater than 12 inches.

RULE.—Set breadth in inches on F to 12 on A or B, then length on A or B will show content in feet on F.

The rule may be stated thus:

12 on A or B : breadth in inches on F : : length in feet on A or B : : content on F.

Ex.—Required the superficial content of a board 22 feet long and 18 inches broad.

12 on A : 18 on F : : 22 on A : 33 on F. Answer in feet.

74. When the breadth is given in feet.

RULE.—Set 10 on F to breadth on A or B, then length on F shows content on A or B.

The rule may be stated thus:

10 on F : breadth on A : length on F : : content on A.

The learner can choose exercises out of any text book.

75. To find the solid content of square or unequal sided timber or stone.

RULE.—By two operations similar to those in superficial or board measure.

The method is easily illustrated by example.

Ex. 1.—Required the solid content of a log 50 feet long, 9 inches broad, and 8 inches deep.

12 in. on F : 9 in. on B : 50 ft. on F : : 37.5 ft. on B.

12 on F : 8 on B : 37.5 on F : : 25 on B: the content required.

Note.—When the timber or stone is square, both operations are performed by one move of the index.

Ex.—Required the content of a log 72 feet long, and 6 inches the side of the square.

12 in. on F : 6 in. on B : : 72 ft. on F : : 36 ft. on B.

12 on F : 6 in. on B : : 36 on F : : 18 on B: the content required.

Ex. 2.—Required the solid content of a tree 18 feet long, and 15 inches the side of the square.

12 on A : 15 on F : 18 on A : : 22½ or 22.5 on F.

12 on A : 15 on F : 22.6 on A : : 28.1+ on F : content required.

76. Round and tapering timber can be measured by applying the rules in any text book to the scale.

Ex.—How many solid feet in a round tree 30 feet long, and the girt 42 inches?

The rule is, to consider quarter of the girt as the side of the square. Applied to the scale the operation is as follows:—

4 or 40 on A : 42 on F : 10 on A : : 10½, 10.5 or 10 in. 6 s. on F.

12 on F : 10.5 on A : 30 on F : : 26 ft. 3 in. on A.

12 on F : 10.5 on A : 26 ft. 3 in. on F : : 22 ft. 11 in. + or 23 ft. nearly on A, which is the content required.

A shorter rule is to assume the diameter as if it were the side of the square—say the diameter is 15 inches and log 20 feet long.

Then, as 12 on A is to 15 on F, so is 20 on A to 25 on F, and (without a move) so is 25 on A to 31 on F. Then, as 100 on F to 7854 on A, so is 31 on F to 24.4 on A: the required solidity in feet.

77. To find the area of a parallelogram; whether it be a square, a rectangle, a rhombus, or a rhomboid.

RULE.—Multiply the length by the perpendicular height, according to the directions given for Multiplication.

Ex. 1.—Required the area of a square whose side is 8 feet 6 inches.

As 100 on F : 8 ft. 6 in. or 8.5 on B : : 8.5 on F : : 72.25 or 72 ft. 3 in., the area required on B.

Ex. 2.—Required the area of a rhombus, whose length is 12, and breadth or height 6.5.

100 on F : 6.5 on A : : 12 on F : : 78 on A. Answer.

78. To find the area of a triangle, when the base and perpendicular are given.

RULE.—Set half the base on F to 10 on A, then perpendicular on A will show area on F.

Ex. 1.—Required the area of a triangle, whose base is 60 and perpendicular height 20.

As 30 on F : 10 on A or B : : 20 on A or B : : 600 on F = the area.

Or, set the base on F to 20 on A or B, then perpendicular on A or B will show area on F.

Ex. 2.—Required the area of a triangle, whose base is 80 and perpendicular height 6.

As 80 on F : 20 on B : : 6 on B : : 240 on F = area required.

In some cases the operation can be performed the more readily by taking the base on A or B to 20 on F, then opposite the perpendicular on F is the area on A or B.

Ex. 3.—What is the area of a triangle, whose base is 120 and height 40?

As 20 on F : 120 on A or B : : 40 on F : : 240 on A or B = the area required.

79. Given any two sides of a right-angled triangle, to find the third side.

CASE I.—When the base and perpendicular are given, to find the hypothenuse.

RULE.—Move the index so that the same point or number on F will at the same time be opposite one of the sides on A, and opposite the other side on B, then the said number on F is the hypothenuse required.

Ex. 1.—In a right-angled triangle the base is 42, and the perpendicular 56; what is the length of the hypothenuse?

Move the index until the working edge is at the point of intersection of the lines from 56 on A and 42 on B, which shows 70 on F = the length of the hypothenuse.

CASE II.—When the hypothenuse and one of the sides are given, to find the remaining side.

RULE.—Set hypothenuse on F to the given side on A, then hypothenuse on F will show the remaining side on B.

Or, set hypothenuse on F to the given side on B, then hypothenuse on F will show the remaining side on A.

Ex.—The hypothenuse of a right-angled triangle is 53, and the base 45: required the perpendicular.

As 53 on F : 45 on A : : 53 on F : : 28 on B.

Or, as 53 on F : 45 on B : : 53 on F : : 28 on A = the length of the perpendicular.

80. To find the area of a trapezium, the diagonal and the two perpendiculars being given.

RULE.—Set 100 on F to the sum of the perpendiculars on A or B, then opposite half the diagonal on F is the required area on A or B.

Ex.—Required the area of a trapezium, whose diagonal is 60, the perpendiculars being 36 and 44 respectively.

As 100 on F : 80 on A or B : : 30 on F : : 2400 on A or B = the required area.

The area of a trapezoid can be determined in nearly the same manner, the only variation in the operation being that the sum of the parallel sides and half the perpendicular are used, instead of the sum of the perpendiculars and half the diagonal, as in the preceding article.

The area of a regular polygon can be found by the directions given for triangles, that is when the side and the perpendicular drawn to it from the centre are given; for a regular polygon can always be divided into as many equal triangles as it has sides.

81. To find the circumference of a circle, when the diameter is given.

RULE.—Set 100 on F to 3.1416 on A or B; or, set 70 on F to 22 on A or B, then opposite diameter on F is circumference on A or B.

Ex.—What is the circumference of a circle, whose diameter is 8?

As 7 on F : 22 on B : : 8 on F : : 25.13 on B = circumference.

Or, as 100 on F : 3.1416 on B : : 8 on F : : 25.13 on B.

Another method:—

As 100 on F : : diameter on A or B : : 3.1416 on F : : circumference on A or B.

Or, as diameter on F : 100 on A or B : : 3.1416 on A or B : circumference on F.

Note.—The diameter of a circle, whose circumference is given, may be found by reversing the operation described in either of the preceding methods.

89. To find the area of a circle.

1st.—When the diameter is given.

RULE.—Set 100 on F to 7854 or 78½ on A or B, then the square of the diameter on F will show the area on A or B.

Ex.—What is the arc of a circle, whose diameter is 9?

As 100 on F : 7854 on A : 81 on F : 6.36 + on A the area.

2d.—When the circumference is given.

RULE.—Set 100 on F to .07958 or 79 6-10 on A or B, then the square of the circumference on F will show the area on A or B.

Ex.—Required the area of a circle, whose circumference is 8.

As 100 on F : .07958 on B : : 64 on F : : 5. on B = area.

90. To find the area of a regular polygon, when only a side is given.

RULE.—Set the index to half the angle at the centre, contained by the two equal sides of any one of the equal triangles into which the polygon can be divided; then 25 on B traced to the index, and thence to A, will show a quantity on A, which, if multiplied by the number of sides the polygon contains, will give a constant multiplier. The product of the square of the side and this multiplier is the area of the polygon. Half the angle at the centre is always determined by dividing 180 degrees by the number of sides. Thus, for a nonagon it is 20°, for an octagon 22½°, for a hexagon 30°, &c.

Ex.—Required the area of a regular pentagon, whose side is 10.

Here, evidently, half the angle at the centre is 36°. Then set the working edge of the index to 36° on the quadrant, and 25 on B traced to F will cut .344 + on A, which, being multiplied by (the number of sides) 5, gives 1.720 + the constant multiplier for pentagons. Consequently the square of the side or 100 × 1.720 + = 172. + the area required.

In computing the areas of regular polygons, the learner can also find the constant multipliers on the scale by means of cotangents; but this properly belongs to Trigonometry, and requires no explanation here. The method already described will be found to answer all purposes without having recourse to any other, so that the learner can at any time form a table of multipliers for polygons in the space of a few minutes.