NUMERICAL EXAMPLES IN HEAT

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649509140

Numerical Examples in Heat by R. E. Day

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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IN

HEAT

BY

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NEW EDITION

LONDON
LONGMANS, GREEN, AND CO.
1885

PREFACE.

IT is not uncommon for the beginner in Physics to experience considerable difficulty in the application of the principles of Science to the solution of problems in which a definite numerical result is asked for. Considering that a knowledge of physical science which cannot be reduced to concrete numbers is no real knowledge at all, it is very important that, at an early stage of his work, the student should have plenty of practice in applying the facts and theories which he reads about in his text-book, to the numerical solution of such questions as are of frequent occurrence in the practical applications of the subject.

This little book is intended to assist those who are studying Heat in acquiring readiness in solving such problems. I should advise the student who uses it to try for himself those examples which are worked out in full before examining their solutions. Even if he fails to obtain correct results his time will not have been wasted, for he will have to be constantly going back to his text-book for the elucidation of particular points, and the care and attention to detail thus rendered necessary will materially assist him in acquiring a firm hold of the principles of the subject.

My friend Mr. C. D. Webb has kindly assisted me in checking the numerical results, but I shall feel indebted to any student who will point out to me any inaccuracies which may have escaped our notice.

R. E. DAY.

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NUMERICAL EXAMPLES IN HEAT.

THERMOMETRIC SCALES.

(1.) The scale of a thermometer between the freezing and the boiling points of water is 120 millimetres long. What is the length of each degree (*a*) on the Centigrade, (*b*) on the Fahrenheit, and (*c*) on the Réaumur scale?

(*a*) In the Centigrade thermometer the freezing point of water is marked 0°, and the boiling point 100°, and therefore the length of a Centigrade degree on this thermometer is

$$C. = \frac{120}{100} = 1 \cdot 2 \text{ millimetre.}$$

(*b*) In Fahrenheit's thermometer the freezing point of water is marked 32°, and the boiling point 212°, and therefore the space between the boiling and the freezing points contains 180 Fahrenheit degrees. Hence the length of a Fahrenheit degree on this thermometer is

$$F. = \frac{120}{180} = \frac{2}{3} \text{ millimetre.}$$

(*c*) In Réaumur's thermometer the freezing point is marked 0°, and the boiling point 80°; hence the length of a Réaumur's degree on this thermometer is

$$R. = \frac{120}{80} = 1 \cdot 5 \text{ millimetre.}$$

(2.) In another thermometer the distance between the boiling and the freezing points is 144 millimetres. What is the length of each degree on the same three scales?

Answer. 1·44, ·8, 1·8 millimetre.

(3.) The length of a Fahrenheit degree on a sensitive thermometer is 20 millimetres. What would be the lengths of a Centigrade and a Réaumur degree?

Answer. C.=36 millimetres; R.=45 millimetres.

(4.) The scale of a *fractional* thermometer which ranges from 95° to 105° C. is 27 centimetres long. Find the length of a Fahrenheit and of a Réaumur degree on this thermometer.

Answer. F.=15 millimetres; R.=33·75 millimetres.

Note.—In many cases, e.g. in the construction of clinical thermometers, a minute subdivision of the scale over a limited range of temperature is required. When the whole scale of a thermometer embraces only a small fraction of the range of temperature between the boiling and freezing points of water the thermometer is called a *fractional* one, and as the range is generally very *open*, minute variations of temperature between the given limits can be easily observed.

(5.) Assuming the mean temperature of the air to be 59° Fahrenheit, what are the corresponding numbers on the Centigrade and Réaumur scales?

For the conversion of 'readings' from one of these scales to either of the other two we have the following equations:

$$F. - 32 = \frac{9}{5}C. = \frac{9}{4}R. \quad . \quad . \quad . \quad . \quad (1)$$

$$C. = \frac{5}{4}R. = \frac{5}{9}(F. - 32) \quad . \quad . \quad (2)$$

$$R. = \frac{4}{5}C. = \frac{4}{9}(F. - 32) \quad . \quad . \quad (3)$$