

To understand how to estimate approximately the reduction of fuel required for reduced speed, and consequently to sanction such reduction of speed as may seem to him to be warranted by the report of the chief engineer, and to satisfy himself before leaving port that there is sufficient coal for the voyage :

To have an intelligent grasp of the general run of pipes and connections in the engine-room, the marking of cocks, the opening and closing of cocks and valves, how mistakes of importance may be made in the confusion of an accident, and how best to guard against such mistakes :

To be capable of being left in charge of the feeding of a set of boilers, to understand the working of the water-gauge, and to be able to guard against being misled by false indications of the gauge-glass :

To understand about blowing down and surfacing, the reasons for doing so, and the danger which may result from the neglect of these under certain circumstances.

A master or mate presenting himself for examination in steam must be understood to have made up for his want of practical experience by reading up about the steam-engine. He ought, therefore, to show that he has given his mind to intelligently understanding the *rationale* of the action of the steam-engine. Under this head he should, therefore, be able to state approximately the quantity of heat required in the formation of steam, the remarkable relation of "latent" heat to "sensible" heat, how much steam can be raised by the combustion of one pound of coal, what horse-power measure is, what indicated horse-power is, what is the action of the slide-valve, the course of the steam through the engine, and the advantage of working expansively, and how the expansive action is shown by the indicator diagram : to know the uses of the various parts of the engines and dynamos used for electric lighting, and how they and the cables are fitted in the hull ; how wires are jointed, insulated, and cased ; why it is desirable that they should be led along places which are dry and accessible ; what is "short circuiting," and what are the causes which produce it ; what is its danger in coal-bunkers and petroleum-carrying steamers ; what are the uses of switches and cut-outs, and why is it so important to prevent short-circuiting taking place.

The candidate has to answer in writing sixteen out of twenty questions selected from the elementary questions (see Appendix B).

Selections for this examination are given on the alphabetic sheet for "Steam." Generally these answers are given by candidates as learned by rote from a book ; the candidate should therefore be asked such *viva voce* questions as will necessitate his giving his answers in different words, so as to discover whether he has the root of the matter in him.

The principal part of the *viva voce* is the examination on board a steamer, preferably one with which he is unacquainted. He is told to look about and try to find out the run of the machinery without the assistance of any one ; the Examiner to be in the engine-room to see that this independent examination is properly carried out. When the candidate reports that he thinks he knows the whole arrangement of the machinery, the Examiner will then question him on the uses of the parts, get him to point out the different cylinders, pumps, valves, condenser, &c. ; also the dynamo, its field-magnets, armature, commutators, brushes, cables, &c. He must show that he understands the run of the pipes in the bilges, not necessarily that he has gone over every one of them, but he ought to be directed to trace at least one important range of pipes, and to thoroughly satisfy the Examiner that he could be safely trusted to

manipulate the valves or cocks in connection therewith. It will not often be practicable for the candidate to be asked to actually work engines under steam, but he must satisfy the Examiner that he knows how to do so, and that he is aware what precautions have to be taken in regard to water in the cylinder, &c. It is most important that a candidate should show that, in the event of an accident depriving him of the assistance of engineers, he knows what to do to safely take his vessel to an anchorage, or to stop the engines and proceed under sail alone.

The examination of a mate in steam is the same as that of a master. The knowledge required has no reference to the mate's position. A mate may be examined, but such examination implies that the mate will one day be a master, when the possession of the knowledge will be an advantage to him in the discharge of his duties as master.

#### APPENDIX G.

##### FORMS USED IN THE EXAMINATIONS OF MARINE ENGINEERS, ENGINEERS OF POWERED VESSELS OTHER THAN STEAM-VESSELS, RIVER ENGINEERS, AND MARINE-ENGINE DRIVERS.

Exn. 1a.—Regulations.

Exn. 1b.—Elementary questions.

Exn. 3.—Application to be examined.

Leaves M1, &c.—Third class : 9 a.m. to 11 a.m.

Leaves N1, &c. " 11 a.m. to 1 p.m.

Exn. 10d.—Face sheet. Second class.

Leaves 201, &c.—Second class : 9 a.m. to 11 a.m.

Leaves 311, &c. " 11 a.m. to 1 p.m.

Leaves 411, &c. " 2 p.m. to 4 p.m.

Exn. 11d.—Face sheet. First class.

Leaves 261, &c.—First class : 9 a.m. to 11 a.m.

Leaves 361, &c. " 11 a.m. to 1 p.m.

Leaves 461, &c. " 2 p.m. to 4 p.m.

Exn. 15.—Examiner's reports.

Exn. 15b.—The form for elementary questions used on the second day of the examination by candidates for second class, and on either the second or the third day by candidates for first class. Candidates who have time between working the arithmetic papers on the first day are allowed to go on with the elementary questions on 15b. The questions are contained in Exn. 1a and in pamphlet Exn. 1b, for use in examination-rooms.

Exn. 15d.—Second-class data sheet for a set of papers.

Exn. 15e.—First-class data sheet for a set of papers.

A corner is cut off the first-class papers to prevent mixing the papers accidentally.

Exn. 17a, b, c, &c.—Subjects for examination in rough working-drawing. The candidates bring their own instruments ; the office supplies drawing-boards, paper, and T squares.

Leaves Q1, &c.—First-class engineers for vessels propelled by gas, oil, fluid, electricity, or other mechanical power than steam :

9 a.m. to 11 a.m.

Leaves R1, &c. Ditto : 11 a.m. to 1 p.m.

Leaves S1, &c.—Second-class engineers for vessels propelled by gas, oil, fluid, electricity, or other mechanical power than steam :

9 a.m. to 11 a.m.

Leaves T1, &c. Ditto : 11 a.m. to 1 p.m.

Leaves O1, &c.—River engineers : 9 a.m. to 11 a.m.

Leaves P1, &c.—" 11 a.m. to 1 p.m.

Leaves for marine-engine drivers : 9 a.m. to 11 a.m.

Exn. 16.—Examiner's authority.