

- (m) The formation of scale and the precipitation of salt in boilers under various conditions, the dangers and losses incidental thereto, and the precautionary measures usually adopted :
- (n) The description of various breakdowns and of defects in marine steam or internal-combustion machinery that have resulted from faulty design, imperfect construction, deterioration, or accident ; the measures whereby these breakdowns and defects might have been prevented ; and the most satisfactory methods of repairing them :
- (o) The causes of spontaneous combustion and the formation of explosive gases in coal holds and bunkers, oil-tanks, machinery spaces, &c., and the precautions to be taken against accident from these causes :
- (p) The application of the indicator ; the interpretation of diagrams obtained by its means ; the construction of approximate diagrams from any given data ; and the determination of the effect in steam and internal-combustion engines of definite alteration of the valves' setting, &c., on the power, efficiency, stress distribution, and working-fluid pressures :
- (q) The general principles involved in the construction and working of the instruments used by engineers on board ship, with special reference to the thermometer, pyrometer, barometer, hydrometer, pressure-gauge, indicator, voltmeter, and ammeter, also of those used in determining the calorific value of fuels and the physical properties of lubricating and fuel oils :
- (r) The lubrication of marine steam and internal-combustion engines and air-compressors ; the source, chemical composition, and properties of the lubricants used ; and the methods employed in testing them.
- (s) The theory and practice of ship-propulsion ; the principles governing the action of the screw propeller and the paddle-wheel ; the effect of any alteration in the pitch, diameter, revolutions, &c., on the ship's speed and the fuel consumption and the solution of problems relating thereto :
- (t) The stability and seaworthiness of ships ; the laws governing the rolling of vessels ; and the estimation numerically of the effect of loading or unloading cargo, moving of weights on board, filling or emptying ballast-tanks, &c. :
- (u) The principles and practice of ship-construction ; the general requirements in regard to the survey of vessels ; and the supervision and direction of essential repairs to the structure of a steel ship :
- (v) The principles involved in the generation of electricity ; the application of electrical energy to the lighting, heating, and propulsion of ships and to the driving of ships' auxiliary machinery ; and the construction and working of the various electric machines, controlling apparatus, measuring and indicating instruments, &c., employed :
- (w) The construction and working of the auxiliary machinery of modern vessels, including the refrigerating-plant, steering engines and gears, hydraulic engines, &c., and the principles governing their action :
- (x) The application of high-pressure steam to the propulsion of ships ; the burning of pulverized coal and oil fuel in the furnaces of marine boilers ; and the construction and working of the various appliances employed.

The extra first-class examination papers will deal mainly with the subjects enumerated in the above syllabus, but they may include questions on other subjects with which a marine engineer should be familiar.

In order to pass, a candidate must obtain not less than 60 per cent. of the total number of marks allotted for the papers.

#### WORKSHOP SERVICE.

56. The requirements in regard to workshop service mentioned in Rule 46 apply to service at works where the making and/or repairing of steam or internal-combustion engines, or similar machinery, of suitable size forms part of the regular business for which the works exist.