1958/57

THE MASTERS AND MATES EXAMINATION REGULATIONS 1952, AMENDMENT NO. 3

COBHAM, Governor-General

ORDER IN COUNCIL

At the Government Buildings at Wellington this 21st day of April 1958

Present:
THE RIGHT HON. W. NASH PRESIDING IN COUNCIL

PURSUANT to the Shipping and Seamen Act 1952, His Excellency the Governor-General, acting by and with the advice and consent of the Executive Council, hereby makes the following regulations.

REGULATIONS

1. (1) These regulations may be cited as the Masters and Mates Examination Regulations 1952, Amendment No. 3, and shall be read together with and deemed part of the Masters and Mates Examination Regulations 1952* (hereinafter referred to as the principal regulations).

(2) These regulations shall come into force on the day after the date of their notification in the *Gazette*.

2. Regulation 20 of the principal regulations is hereby amended as follows:

(a) By omitting from paragraph (a) the words "Part 1", and substituting the words "Part A":

(b) By omitting from paragraph (b) the words "Part 2", and substituting the words "Part B".

3. Regulation 25 of the principal regulations is hereby amended by omitting so much as relates to the examination for extra master, and substituting the following:

"*IV. Extra Master*

Part A: First Week—	Hours	Marks
Monday a.m.—Commercial and Legal Knowledge	3	250
Monday p.m.—Ship Construction and Maintenance	3	250
Tuesday a.m.—Chart Construction and Marine Surveying	3	250
Tuesday p.m.—Meteorology, Oceanography, and Economic Geography	3	250
		1,000

*S.R. 1952/147
Amendment No. 1: S.R. 1953/110
Amendment No. 2: S.R. 1957/155

Part B: Second Week—		Hours	Marks
Monday	*a.m.*—Mathematics	4	200
Tuesday	*a.m.*—General Physics	4	200
Wednesday	*a.m.*—Magnetism and Electricity	4	200
Thursday	*a.m.*—Theoretical Naval Architecture and Hydrostatics	3	200
Thursday	*p.m.*—Navigation and Navigational Aids	3	200
			1,000

A candidate shall be required to obtain 70 per cent of the total marks for each part in order to pass, and he shall be required to reach a minimum of 50 per cent in each subject.

The oral examination in seamanship may be taken at the end of either part of the examination if the candidate is taking the parts separately."

4. Regulation 30 of the principal regulations is hereby amended as follows:

(a) By omitting from the part relating to foreign going certificates the words "Part I", and substituting the words "Part A":

(b) By omitting from the same part the words "Part II", and substituting the words "Part B".

5. Regulation 34 of the principal regulations is hereby revoked.

6. The principal regulations are hereby amended by revoking regulations 122 to 124, and substituting the following regulations:

"SPECIAL REQUIREMENTS

"122. (1) The examination for an extra master's certificate is voluntary, and is intended for such persons as wish to prove their superior qualifications and are desirous of having certificates of the highest grade granted by the Marine Department. It may be taken at any time after the officer has passed the examination for a master's (foreign going) certificate.

(2) The syllabus for any given subject is to be regarded as including the syllabus (if any) for certificates of lower grade.

(3) The mathematical and scientific knowledge required from candidates is such as to enable them to have a thorough understanding of their technical subjects.

(4) Candidates shall be examined orally in seamanship.

(5) The written examination is divided into two parts, and a candidate shall have the option of taking them together or separately. Success in one part shall be recorded by endorsement to that effect on the candidate's master's (foreign going) certificate. A candidate failing in either part in not more than one subject may, at the discretion of the Principal Examiner of Masters and Mates, be re-examined in that subject alone within twelve months from the date the appropriate part of the examination was taken. The marks the candidate must attain in the subject on re-examination in order to pass shall be determined by the Principal Examiner. If the candidate then passes in the subject, he shall be deemed to have passed in the appropriate part of the examination; if he fails or does not present himself for re-examination within the prescribed period, he shall be deemed to have failed in that part.

"SCOPE OF EXAMINATION

"123. The candidate must satisfy the examiner in the following subjects:

(a) Written Examination, Part A—

Paper 1—Commercial and Legal Knowledge.
Paper 2—Ship Construction and Maintenance.
Paper 3—Chart Construction and Marine Surveying.
Paper 4—Meteorology, Oceanography, and Economic Geography.

(b) Written Examination, Part B—

Paper 5—Mathematics.
Paper 6—General Physics.
Paper 7—Magnetism and Electricity.
Paper 8—Theoretical Naval Architecture and Hydrostatics.
Paper 9—Navigation and Navigational Aids.

"SYLLABUS

"124. The syllabus for the examination is as follows:

(a) WRITTEN EXAMINATION—PART A

Paper 1—Commercial and Legal Knowledge (Three Hours)

(a) The law relating to registry, masters and seamen, passenger and emigrant ships as it concerns the shipmaster. Safety of ships (Classes I and VII); special shipping inquiries and Courts covered by the United Kingdom Merchant Shipping Acts; delivery of goods; carriage of goods by sea; wreck and salvage; pilotage; oil pollution. Content of 'M' Notices issued by the United Kingdom Ministry of Transport and Civil Aviation.

(b) The general management of ship's business, documents and procedure with Customs and Mercantile Marine Offices as they concern the shipmaster.

(c) Charter parties: the contract, performance of the contract; bills of lading; liability of shipowners; demurrage; freight; lien; damages.

(d) Marine Insurance: different kinds of marine policies; the slip; insurable interest; disclosures and representations; express and implied warranties; meanings of the terms and clauses used in marine insurance policies; total loss—actual and constructive; abandonment; general average; particular average; the "memorandum"; York—Antwerp Rules.

(e) Administration and working of ports. Use of quays, sheds, warehouses, docks, and waterside termini. Cranes and their use—steam, electric, hydraulic, mobile, including floating coaling apparatus, mineral and grain elevators. Other appliances used in cargo handling. Graving docks. Floating docks.

Paper 2—Ship Construction and Maintenance (Three Hours)

(a) Types of ships in relation to strength, form, and construction. Materials used in ship construction with a knowledge of their properties, uses, and limitations. Annealing and testing of materials.

(b) Maintenance of structure and equipment, including modern methods of combating corrosion.

(c) Construction: A comprehensive knowledge of the various members of construction together with their functions and the methods employed in connecting them to other parts of the structure.

(d) Types of welding processes, viz., oxy-acetylene, resistance, electric arc welding.

(e) Types of weld (butt, fillet); details of butt, seam and lap joints; forms of weld (intermittent, chain intermittent, staggered intermittent). Lloyds' requirements in respect of these.

(f) Advantages and disadvantages of welding. The common faults, such as lack of penetration, porosity. Tests for welded joints and materials. Welding sequences, fabrication.

(g) General ideas on subdivision.

(h) Fire protection and warning systems.

(i) Shipyard Procedure: A general knowledge of the practices followed from drawing office to completed ship, including launching.

(j) Repairs on account of damage and wastage. Emergency repairs.

(k) Load line: Assigning authorities, surveys, certificates. A general knowledge of the conditions of assignment of freeboards and of the factors affecting the computation of freeboard.

(l) Tonnage: A knowledge of the general principles governing the assessment of British Tonnage. Suez and Panama Canal Certificates.

(m) British Classification Societies: Their functions and requirements as regards construction and survey of steel ships.

(n) Trials. The conducting of speed and manoeuvrability trials.

Paper 3—Chart Construction and Marine Surveying (Three Hours)

(a) The candidate will be required to produce two completed chart frameworks certified as his own work. These shall consist of:

(i) A Mercator Chart on a scale of 1:500,000 (at latitude of 62°00′) between latitude of 61° 20′ S. and latitude 62° 40′ S. and between longitude 73° 00′ E. and longitude 77° 00′ E. The chart must show a short length of hypothetical coast line and not less than two depth contours. All buoys, wreck, light, and other symbols and all printing must conform to current Admiralty chart practice. Spheroidal meridional part tables are to be used to determine the latitude scale.

(ii) A plan, scale 1:25,000, not less than 12 in. by 12 in. overall, embracing a point of reference in 51° 10′ 55″ N., 17° 08′ 38″ W. The plan shall be graduated in minutes and tenths for latitude and longitude and shall also have an inserted scale of nautical miles and cables. No topographical details will be required. Assume 6,083 ft. per minute of latitude and 3,825 ft. per minute of longitude.

This work must be executed in ink and all relevant calculations must be included with each chart.

Each chart must bear the legend 'I certify this chart is my own unaided work' and must be signed and dated by the candidate.

In the event of failure in this paper or in Part A as a whole, the candidate will be required to produce an additional chart which may be either (i) or (ii) above at each subsequent attempt.

These charts will be sent to the Principal Examiner, Marine Department, Wellington, for examination and approval. Candidates should, in their own interests, submit these charts as early as possible before the date of the examination.

(b) The theory and construction of charts on Mercator's principle. Candidates will be asked to construct such a chart and plot points or to expand a given diagram or block. This work may be executed in pencil.

(c) Hydrographic surveying. The framework of the survey, triangulation, surveying marks, traverses, heights and levelling, plotting sheet, soundings, coastlining, topography, tides and tidal streams, surveying out of sight of land, running surveys, sketch surveys, surveys of a river, searching for reported dangers. Methods of fixing shore positions in connection with hydrographic surveying. An understanding of the principles of the instruments used, but not a detailed knowledge, will be required.

Paper 4—Meteorology, Oceanography, and Economic Geography (Three Hours)

(a) Meteorology—

(i) The atmosphere; variations in pressure, density, and temperature; humidity, saturation, dew point, lapse rates, potential temperature; stability and instability, turbulence; movement of air masses, convection, radiation, wind, including upper wind.

(ii) Forecasting and its organisation; general weather synopsis, the frontal theory, the formation and movement of depressions and other weather systems, cloud development, supercooled water, formation of fog and mist, rain, hail, snow, thunderstorms.

(iii) Climatology; the various types of climate; the general distribution of meteorological elements and their effects on climate, seasonal changes, insolation, prevailing winds; local weather characteristics treated generally.

(iv) Formation of ice, floating ice, ice limits. Ice Patrol and Observation Services.

(b) Oceanography—

General characteristics of the seas: ocean deeps, surface temperature, density, salinity, oceanic circulation.

(c) Economic Geography—

(i) The geographical and economic factors, determining world production and the exchange of goods, transport and world trade.

(ii) Principal products and their sources of supply:

Food: cereals, meat, dairy produce, fish, fruit, sugar, vegetable oils, tea, and coffee.

Raw Materials: timber, rubber, sulphur, iron and steel, coal, salt, ores, oils and their products, textile plants, and wool.

Manufactured Goods: industrial production. Trade in manufactured goods.

(b) WRITTEN EXAMINATION—PART B

Paper 5—Mathematics (Four Hours)

(a) Theory of quadratic equations and limits of the function for real values of the variable. Problems involving quadratic equations.

(b) Transformation of equations $y = ax^b$ and $y = ab^x$ to straight line graphs. Determination of constants from experimental data.

(c) Properties of hyperbolae of navigational importance.

(d) Trigonometrical functions of compound and multiple angles of any magnitude. Transformation of sums of trigonometrical functions into products and *vice versa*. Plane trigonometrical problems in two or three dimensions.

(e) The geometrical properties of the sphere and spherical triangles. Proofs of the following formulae: cosine, sine, four-part, haversine, Napier's Rules, and area in terms of spherical excess. The polar triangle. Solution of right angled quadrantal and oblique spherical triangles.

(f) The theory of the stereographic projection.

(g) Derivation of formulae used in the compilation of short method navigational tables.

(h) Areas and volumes of plane and solid figures. Simpson's Rules for curvilinear figures.

(i) The use of the binomial theorem for positive, negative, and fractional real indices. Approximations.

(j) Use (without proof) of the expansions of sin x, cos x, and e^x. Approximation. Limits.

(k) Gradient of a line, the differential coefficient, rate of change. Differentiation of a function, a function of a function, a product and a quotient (including trigonometrical, inverse trigonometrical, and logarithmic functions). Application to problems on rates of increase, small errors and maxima and minima.

(l) The idea of integration as a summation. The definite integral. Integration between limits. Application of integration to areas and volumes. Approximate integration by Simpson's Rules.

(m) Systematic and random errors. Calculation of mean and standard deviation of a large sample. Standard error and confidence limits of the mean.

Paper 6—General Physics (Four Hours)

(a) Statics—

(i) Composition and resolution of forces. Parallel forces. Moments and Couples. Conditions for equilibrium under coplaner forces. Stress, strain, Hooke's Law (including Young's Modulus of Elasticity), shearing forces and bending moments of simply supported beams and cantilevers under vertical point loads and uniformly distributed loads over the whole or part of the span.

(ii) Centres of gravity of laminae and solids. Stable and unstable equilibrium.

(iii) Simple machines and calculations thereon with or without friction.

(iv) Boyle's Law. Barometer. Pressure gauges. Hydraulic press. Simple piston-type water pumps.

(b) Dynamics—

(i) Composition and resolution of velocities and accelerations. Relative velocity. Mass. Weight. Newton's Laws of motion. Motion under gravity. Work, power, kinetic and potential energy. Momentum. Conservation of momentum. Direct impacts; coefficient of restitution.

(ii) Motion in a circle. Simple harmonic motion. Simple pendulum. Vibration of a mass at the end of an elastic string. Newton's Laws applied to rotation, i.e., the relation between moment of inertia, applied couple and angular acceleration. Angular momentum. Kinetic energy of rotation.

(c) Heat and Temperature—

(i) Transference of heat; conduction, convection, and radiation, Newton's Laws of cooling. Thermal conductivity; emissivity; thermometry; temperature scales.

(ii) Coefficient of linear, superficial, and volume expansion of solids, liquids and gases; change of state; the triple point.

(iii) Specific heat, latent heat, and thermal capacity. Superheat. Charles's Law; isothermal and adiabatic expansion and compression of gases; refrigeration.

(iv) Heat as a form of energy; mechanical equivalent of heat.

(v) Vapour pressure; hygrometry; dew point and relative humidity.

(d) Light—

(i) The laws of reflection. Reflection at plane and spherical mirrors. Formation of real and virtual images.

(ii) The law of refraction; index of refraction; critical angle; total internal reflection. Real and apparent depth. Prisms. Thin lenses. Formation of images by lenses. Description of achromatic lenses.

(iii) The refracting and reflecting telescope; prism binoculars; sextant; azimuth mirror.

(iv) Intensity of illumination, candle power and the lumen.

(v) Velocity of light. Light waves. The visible spectrum. Dispersion. Rainbows and coronae. Mirages and looming.

(e) Sound—

Production and propagation of sound. Frequency, wave length, velocity. Principle of siren. Effect of temperature and wind on the transmission of sound. Factors influencing velocity in air and water. Reflection, echoes. Beats. Doppler effect.

Paper 7—Magnetism and Electricity (Four Hours)

(a) Magnetism—

(i) Magnetic properties of materials, induction, susceptibility, and permeability. Magnetic effects of electric currents, including calculations.

(ii) Terrestrial magnetism. Dip, total force, horizontal force, and vertical force. Effects on the deviation of the compass accompanying change in the values of these elements. Variation.

(iii) Ship's magnetism. Hard and soft iron. Permanent, subpermanent, and induced magnetism. Components P, Q, R, the rods a, b, c, d, e, f, g, h, k. The approximate coefficients A, B, C, D, E. Heeling error. Lambda, lambda two and mu.

(iv) General principles of compass correction. Methods of finding, and compensating a compass for, the various components which might cause deviation, including the effects of heel and trim.

(v) Compensation by use of the Kelvin deflector. Principle of the deflector method and information which can be deduced from readings obtained.

(vi) The siting and lining up of compasses with due regard to the proximity of magnetic material, electrical devices, and other disturbing influences.

(vii) The theory of degaussing in ships fitted with M coils and compass compensation by means of B and heeling error coils.

(viii) Swinging ship and the analysis of a deviation table.

(b) Electricity—

Candidates will be expected to show a full knowledge of the ground covered for the two previous grades. In addition, questions will be set calling for a knowledge of the following:

(i) D.C. Circuits—

(a) Kirchoff's Laws and their applications.

(b) Measurement of resistance by simple bridge method. Principle of Megger and its use.

(c) Principles of Electrolysis; concept of the principles of Cathodic Protection.

(d) A qualitative treatment of the effect of inductance in a D.C. circuit.

(e) A qualitative treatment of the charge and discharge of a condenser in a resistive circuit.

(ii) D.C. Motors and Generators—

(a) Simple relationships between speed, field strength, induced e.m.f., armature current, and torque. Behaviour of shunt, series, and compound-wound machines. The concept of power losses in a machine; efficiency. Simple starter for D.C. shunt-wound motor. Voltage control of shunt-wound dynamo.

(b) The magnetic relay as exemplified in simple shunt motor starter with no-volt and overload releases.

(iii) A.C. Motors and Generators—

The principles of rotating, armature, rotating field and inductor type generators and induction motors.

(iv) A.C. Circuits—

(a) Peak, Average, and Root Mean Square values of sinusoidal alternating voltages and currents.

(b) A quantitative treatment of the effect of resistance, inductance, and capacitance in a series A.C. circuit; reactance.

(c) Simple examples of vector treatment of combinations of resistance, inductance or capacitance or both in a series A.C. circuit; impedance; resonance.

(d) Power in an A.C. circuit; power factor.

(v) High Frequency Circuits—

(a) The fundamental principles of heterodyne and superheterodyne reception.

(b) Principles of suppression of radio interference from electrical equipment.

(c) An elementary knowledge of the principles of directional aerials. The interpretation of the horizontal polar diagram, as exemplified in the case of the simple loop aerial and radar aerial.

(d) A concept of the meaning of the term "Aerial Gain" and a knowledge of the use of the decibel as a unit used in the measurement of relative power.

(e) The causes of fixed and variable errors to which navigational aids, used in British ships, are subject.

Paper 8—Theoretical Naval Architecture and Hydrostatics (Three Hours)

(a) Density; specific gravity; flotation and buoyancy. The hydrometer. Archimedes' Principle; centre of pressure; fluid pressure and its relation to total thrust. Stability of floating bodies. Calculation of the centre of pressure by the common rules.

(b) Volumes and areas—

The theory and applications of the common rules to determine the waterplane and cross-sectional areas and displacement of a vessel, the centre of buoyancy and the centre of flotation.

(c) Moments of inertia—

The determination of longitudinal and transverse moment of inertia of a waterplane.

(d) Transverse stability—

(i) The general proof of BM = I/V. Applications of this formula to box-shaped and ship-shaped vessels. Attwood's formula for statical stability.

(ii) Proof of "wall-sided" formula, and its application to—

(a) Angle of loll of unstable ship.

(b) Heel due to shifting a weight transversely in a vessel with zero GM.

(iii) Theory and calculations in connection with the admission of water, especially applied to—

Increase in draught due to bilging of box-shaped vessels.
Permeability.
Effect of free surface.
Heel due to admission of water in a side compartment.

(e) Longitudinal stability—

Proof of the formula for M.C.T. 1″.
Calculations involving change of trim due to—
Movement of weight(s) longitudinally.
Addition of weights.
Bilging of compartments.
Change of density of water in which ship floats. (C.F. not vertically above C.B.)
Problems involving draught when C.F. is not at mid-length. (Correction for layer.)

(f) Drydocking—

(i) An appreciation of and calculations involved in—

(a) Change in stability conditions up to point when vessel is borne by the blocks.

(b) Change in stability conditions after waterlevel falls.

(c) Draught at which ship becomes unstable.

(ii) A knowledge of precautions to be taken.

(g) Stresses and strains, bending moments and shearing forces—

A knowledge of stresses and strains experienced by ships. An understanding of the "curves of loads", "curves of shearing force" and "curves of bending moments" of floating vessels.

(h) Stability data—

A comprehensive knowledge of the uses of all kinds of hydrostatic, stability and stress data supplied to ships.

(i) Rolling of ships—

Unresisted rolling in still water. A non-mathematical knowledge of rolling amongst waves.

Paper 9—Navigation and Navigational Aids (Three Hours)

(a) The "cocked hat" and errors with astronomical and terrestrial position lines.

(b) Terrestrial refraction. Dip and distance of sea and shore horizons.

(c) Derivation of the formulae and use of the following:

Ex Meridian Tables.

Pole Star corrections and Tables.

A, B, and C Tables.

Rates of change of azimuth and altitude.

Maximum and Meridian Altitudes.

Longitude by Equal Altitudes.

The Equation of Equal Altitudes.

Connection between errors in altitude, longitude, latitude, and hour angle.

Position lines when altitude is very large. Rising and setting of sun and moon, twilight. Theory of the sextant and sextant vernier. Sextant corrections: collimation, centreing error, sextant parallax, use of artificial horizons and back angles. Formulae and their derivation for parallax and augmentation of moon's semi-diameter. Use of radio D/F position lines, curve of constant bearing and proof of convergency. Shape of the earth. Geocentric and geographic latitude, middle latitude.

Equation of time and its components. Apparent motion of sun, moon, and planets. Sidereal, synodic, and nodical periods. Saros cycle. General ideas of precession and nutation. Different measurements of years, months, and days. A general knowledge of ecliptic limits. Elementary knowledge of Kepler's Laws. Star magnitudes. Content of Abridged Nautical Almanac.

(d) Description and use of all apparatus used to safeguard navigation in the open sea and coastwise, including radar and radio aids, radio direction finding, and sonic sounding gear.

(e) Theory of tides; tidal prediction; tide tables and their use; tidal streams; abnormal tides.

(f) Theory of the gyroscope and the gyroscopic compass. A sound theoretical and practical knowledge of the Brown or Sperry M.N. type compass, including ballistic control, methods of damping, follow up and repeater system, ballistic deflection, course and speed error, rolling errors.

(c) ORAL EXAMINATION

The candidate will be examined in the following syllabus, which is that laid down for a master's (foreign-going) certificate. He will, however, be expected to reach a higher standard in his answers than a candidate for the master's certificate. Signals will not form part of the examination.

(a) (i) Exceptional circumstances. Loss of rudder; shifting a damaged rudder. Construction of jury rudders. Making and launching of rafts. Collision. Leaks. Damage of all kinds. Running repairs and precautions in case of accidents. Grounding—methods of refloating. Beaching a vessel. Steps to be taken when disabled and in distress.

(ii) Preservation of crew and passengers in the event of wreck. Abandoning a wrecked ship. Rockets and rocket apparatus. Communications with the shore.

(iii) Assisting a vessel in distress. Rescuing crew of a disabled ship.

(iv) Towing and being towed.

(v) Bad weather manoeuvres. Precautions at anchor and at sea. Use of oil. Anchoring and working anchors and cables in all circumstances. Approaching rivers and harbours and manoeuvring in them.

(vi) Drydocking. General procedure and precautions to be observed. Distribution of weight. Drydocking with full cargo for inspection of propellers or shafting. Bilge blocks. Leaving the vessel water borne. Putting into port with damage to ship or cargo or both, both from business and technical points of view. Safeguarding of cargo.

(vii) Prevention of fire at sea. Spontaneous combustion. Full knowledge of the use of fire appliances and the precautions to be taken in their use. Special reference to the extinguishing of oil fuel fires.

(viii) Methods of fumigating holds and living spaces and safeguards in applying them.

(ix) General organisation of ship's work and handling and training of crew. A knowledge of training facilities available to members of the crew.

(x) Compensation and adjustment of compasses. Demonstrations of Beall's Compass Deviascope or Instructional Binnacle.

(b) (i) A full knowledge of the content and application of the Regulations for Preventing Collisions at Sea. (Candidates will not be placed in the position of handling a sailing ship, but will be expected to recognise a sailing ship's lights and to have a knowledge of her possible manoeuvres according to the direction of the wind.)

(ii) Distress and pilot signals; penalties for misuse.

(iii) British uniform system of buoyage; wreck marking system.

(iv) A knowledge of the contents of the Book of Merchant Shipping Notices issued by the United Kingdom Ministry of Transport and Civil Aviation and the use of Admiralty Notices to Mariners."

7. Appendix II to the principal regulations is hereby amended by omitting so much as relates to the examination for extra master's certificate, and substituting the following:

"Extra Master

PART A

COMMERCIAL AND LEGAL KNOWLEDGE

Paper 1—(Three Hours)

N.B. Candidates are not to answer more than 6 questions.

1. Discuss the difference between a possessory lien and a maritime lien and give an example of each.

2. (a) What procedure should be carried out by members of the crew of a Commonwealth ship registered in the United Kingdom if they consider that provisions issued to them are of poor quality or unfit for use?

(b) What is the procedure if an examination of the provisions is made and what penalty may be imposed on, or compensation made to, the complainants as a result of such examination?

3. Give a brief description of portal and semi-portal cranes. Under what circumstances would the latter be more suitable for working on a quay?

4. Discuss the advantages and disadvantages of finger jetties or finger piers. Where such a system is to be adopted in the construction of a port, show with the aid of a sketch how the disadvantages may be minimised?

5. Explain what is meant by the term 'stoppage in transitu' with regard to the carriage of goods by sea. What conditions must be satisfied in order that the right to stoppage may exist; how is the right exercised and how may such a right be defeated?

6. What provision is made by the United Kingdom Merchant Shipping Acts for registering a ship:

(a) Where the ship is built in the United Kingdom for first registry in a Commonwealth country other than the United Kingdom:

(b) Where a foreign ship in a foreign port becomes the property of British owners and is to be registered in the United Kingdom?

7. What conditions must be satisfied if the saving of maritime property is to be regarded as salvage?

8. Describe a modern floating dock and discuss any advantages or disadvantages it may have, compared with a graving dock.

9. Give details of any limitation of the carrier's liability for loss or damage to goods under the Carriage of Goods by Sea Act 1924 of the United Kingdom Parliament.

SHIP CONSTRUCTION AND MAINTENANCE

Paper 2—(Three Hours)

N.B. Candidates are not to answer more than 6 questions.

1. What is meant by tension, compression, bending and shearing stresses? Discuss fully the conditions under which the ship's structure may be subjected to these stresses.

2. Give details and principle of the cathodic protection equipment installed in some modern tankers to prevent internal corrosion.

3. Compare the advantages and disadvantages of electric welding with riveting. What are the essentials for efficient electric welding? Discuss three principal types of welded joint.

4. Explain floodable length and factor of subdivision as used in the International Convention for Safety of Life at Sea 1948, and the United Kingdom 1948 Construction Rules. How, in general terms, are the number of watertight subdivisions determined for a passenger vessel?

5. Outline the method of building the hull of a ship, from laying the keel to plating in the main deck.

6. Upon what does the value of a superstructure as a factor in reducing freeboard depend? Give your answer in detail and state where the actual deductions are tabulated.

7. Explain, in general terms, the difference between Suez and Panama tonnage certificates.

8. (a) Discuss the principal features which influence the turning of a ship under way by means of the rudder.

(b) What is meant by 'tactical diameter', 'advance', and 'drift angle'? Illustrate your answer with a diagram.

Chart Construction and Marine Surveying

Paper 3—(Three Hours)

N.B. Candidates are not to answer more than 4 questions, which must include number 1.

1. Construct, in pencil, a skeleton Mercator's chart extending from latitude 34° 20′ S. to 35° 30′ S. and from longitude 175° 30′ E. to 176° 30′ E. to a scale of 12·1 in. equal to one degree of longitude. Subdivide the Eastern meridian and the Southern parallel to 0·5 of a minute and insert the following:

The parallel of 35° S.

The meridian of 176° E.

Beacon 'A' fitted with radar reflector in position 35° 05′ S., 176° 16′ E.

Triangulation station 'B' in position 35° 00′ S., 176° 25·5′ E.

A pinnacle rock 'C' which covers and uncovers with the tide; the height of the rock being 7 ft. above chart datum. Position 34° 28′ S., 176° 15′ E.

2. When carrying out a hydrographic survey, soundings are taken at all states of the tide. Describe the method employed to reduce these soundings to a common datum.

3. Describe how the length of a base line may be determined by observations of the vertical angle subtended by a ship's mast. Under what circumstances would this method be used?

4. What are false stations? Give an example showing the use made of such a station.

5. Describe the principles involved and the method employed in determining the height of prominent land features by means of the aneroid barometer.

METEOROLOGY, OCEANOGRAPHY, AND ECONOMIC GEOGRAPHY

Paper 4—(Three Hours)

N.B. Candidates are not to answer more than 7 questions.

1. Discuss the tidal characteristics of waters around the United Kingdom and their economic value.

2. Give examples and explain why lines joining places of equal sea temperature in some places tend to follow meridians and in others to follow the parallels of latitude.

3. Explain the effect of oceanic circulation on the climate of adjacent land masses.

4. Examine and compare the exchange of goods between a temperate and a tropical country.

5. Write notes on the world importance of Canada as a wheat producing country.

6. Explain the importance of pipeline transportation of petroleum and its possible effect on marine transport.

7. Discuss the saying: 'Rain before seven, fine before eleven'.

8. Enumerate the principal instruments used for weather forecasting at sea and fully describe any one of them.

9. Compare the surface weather associated with the passage of warm and cold fronts over a stationary observer.

PART B

MATHEMATICS

Paper 5—(Four Hours)

N.B. Candidates are not to answer more than 8 questions.

1. Prove that in any spherical triangle

$$\frac{\sin (A + B)}{\sin C} = \frac{\cos a + \cos b}{1 + \cos c}$$

2. Find the value of b in the following:

$$x \log_e b^y + y \log_e (b + 1)^x = xy$$

(x and $y \neq 0$) ($e = 2{\cdot}7183$)

3. Differentiate with respect to x:

(a) $(3x^2 - 4x + 2)^5$

(b) $\log_e (\tan 2x + \sec 2x)$

(c) $e^{-x^2 \sin^{-1}x}$

4. Evaluate

(a) $\int_{-0{\cdot}5}^{+0{\cdot}5} (3x - 1)^2 \, dx$

(b) $\int_0^2 \frac{dx}{(1 + x^2)}$

5. The vessels of a certain company regularly use the Great Circle track from A to B, a calculated distance of 3,527 miles. The following are the total distances steamed (to the nearest 5 miles) extracted from the log books for 130 passages.

Estimate the mean excess distance steamed and find the standard error of your estimate.

Distance steamed	3,540	3,545	3,550	3,555	3,560	3,565	3,570	3,575
Number of passages	10	20	27	26	23	14	9	1

6. Sketch the curve whose equation is $y^2 = x\ (1 - x)^2$ between $x = 0$ and 1 and find the volume of the solid obtained by rotating the loop about the x axis.

7. Expand $(1 + x)^n$ binomially up to terms containing x^4 and hence evaluate

$\sqrt{(1{\cdot}2)^3}$ to four places of decimals.

8. The record times to run varying distances is believed to follow a law of the form $t = a\ d^b$.

From certain record tables we find

Distance in yards ..... (d)	150	200	220	440	880	1,000
Time in seconds ..... (t)	14·6	19·4	21·8	48·4	112·2	132·4

By a suitable transformation draw the straight line graph for these particulars and from your graph (or otherwise) estimate the constants of the 'law'.

9. A and B are two points 4·9 miles apart due east and west. A point X moves so that its distance is constantly 1·3 miles nearer A than B. Draw to the scale of 2 miles to the inch the locus of the point X for that part of its path that lies within a distance of 6 miles from the nearer fixed point.

10. A flagstaff is broken off above the ground and the head strikes the ground at a point 20 ft. from its base. It is restored to its original condition and breaks again 5 ft. nearer the ground, the head this time striking a point 10 ft. further from the base.

Find the height of the flagstaff before it was broken.

11. Explain how the orthomorphic property is established in a stereographic projection.

12. Prove that $\text{shav } c = \text{shav } (a \sim b) \text{ shav } C + \text{shav } (a + b) \text{ shav } C$ in the supplementary haversine formula.

General Physics

Paper 6—(Four Hours)

N.B. Candidates are not to answer more than 8 questions. The value of g should be taken as 32 ft./sec.^{2} and π as $\frac{22}{7}$ unless otherwise stated.

1. A simple form of astronomical telescope is used to view an object at 70 ft. distance, the eyepiece being adjusted for 10 in. which is the nearest distinct vision of the image. Find the magnification. Focal lengths of object lens and eyepiece are 24 in. and 5 in. respectively.

2. Explain fully what is meant by 'beats' with reference to two sounding bodies. Two sounding bodies of frequencies x and y are placed near to each other. What will be the number of beats per second?

3. The specific heat of a gas at constant pressure is 3·38 calories per gram and the density of the gas at 0° C. and 76 cms. of mercury (s.g. 13·6) is 0·089 grams per litre. Calculate the specific heat of the gas at constant volume. Mechanical equivalent of heat is $4{\cdot}18 \times 10^7$ ergs per calorie, and g = 981 cm./sec.^{2}.

4. One limb A of a U-tube containing mercury is closed and the other limb B is open, there being a vacuum at the top of A, the difference of level of the mercury in the two limbs being 30 in. The top of B is then sealed, thus enclosing a volume of air which occupies a length of 20 in. of the tube at atmospheric pressure. If the top of A is then opened, find how far the mercury will rise in B.

5. A sphere rests on a rough inclined plane and is supported by a horizontal string attached to the highest point of the sphere and to the plane. If the coefficient of friction between sphere and plane is 0·75, find the inclination of the plane when the sphere is on the point of slipping.

6. A body weighing 12 lb. is suspended by a spring and makes three complete vertical oscillations per second. Find how far the spring would be stretched by a load of 10 lb. hanging at rest.

7. Two particles whose masses are in the ration 3 : 4 are placed at the rim of a smooth hemispherical bowl of inside diameter 4 ft., so that they are diametrically opposite each other, the rim of the bowl being horizontal. They are then allowed to slide down the inside of the bowl so that they meet at the lowest point. Find the vertical distance each will travel after impact if the coefficient of restitution beween the particles is 0·5.

8. Two equal beams AB and AC are smoothly jointed at A, and B is joined by a cord to the mid point of AC. The beams rest with B and C on a smooth horizontal plane, A being vertically above the line joining B and C. The angle BAC = 60°. Find the tension in the cord in terms of the weight of a beam.

9. Evolve an expression for the distance of the centre of gravity of a solid hemisphere from the centre of its plane base.

10. A motor car weighing 25 cwt. is travelling at a uniform speed of 20 m.p.h. on level ground. On reaching a slope of $\text{Sin}^{-1}\frac{1}{20}$, the engine is shut off and the car runs free wheel down the slope at the same uniform speed. At what horsepower was the engine working on the level ground?

11. What is the shortest time in which a weight of 4 tons can be raised by a derrick runner through a distance of 72 ft., starting and finishing at rest, when the tension in the runner is not to exceed 5 tons?

Magnetism and Electricity

Paper 7—(Four Hours)

N.B. Candidates are not to answer more than 6 questions.

1. A vessel was swung for compass adjustment off Liverpool (H = 0·18, Z = 0·44) after major structure alterations. In making the adjustment, the Flinders bar correcting 3½° of deviation was left in place on the fore side of the binnacle and the spheres correcting a coefficient

D of 3° were also left in place athwartships. After the heeling error had been corrected, 4° of coefficient B showing was corrected by fore and aft magnets, red ends forward, and 7° of coefficient C was corrected by athwartship magnets, red ends to port. No residual deviations were found.

On arrival in New Zealand (H = 0·21, Z = − 0·55) the ship was swung with correctors still in place and the following deviations found with the ship upright.

Ships Hd. Comp.	Dev.
N	$5\frac{3}{4}°$ E
NE	$4\frac{3}{4}°$ E
E	1° E
SE	$4\frac{3}{4}°$ W
S	$7\frac{3}{4}°$ W
SW	$4\frac{3}{4}°$ W
W	1° E
NW	$4\frac{3}{4}°$ E

State what alteration should be made to the correctors in New Zealand.

2. What is the magnetic moment of the magnet of a vertical force instrument if the balance weight of 80 milligrams must be set 2·2 cms. from the fulcrum when the instrument is used to adjust the heeling error at a compass position on board ship? (H = 0·2 and dip = 71°.) The ship's multiplier is 0·88.

3. Explain with the aid of diagrams the probable effect on coefficient B of (a) raising, and (b) lowering the heeling error magnets in the binnacle, assuming that coefficient B has been initially corrected with the heeling error magnets in place.

4. An iron ring of circumference 40 cms. and cross section diameter 0·5 cms. is wound with 500 turns of wire in which a current of 2 amps. flows. At one part of the ring there is an air gap 5 mm. wide. Find the strength of the magnetic field in this gap if the permeability of the iron is 800.

5. (a) What do you understand by back E.M.F.?

(b) A battery of twenty accumulators (joined in series) is being charged by a dynamo with an E.M.F. of 112 volts and an internal resistance of 0·2 ohms. Each accumulator has an E.M.F. of 2 volts and an internal resistance of 0·1 ohm; in series with the accumulators is a resistance of 5 ohms. Find the ratio of the electric power usefully employed in charging the accumulators to the total electrical power developed by the dynamo.

6. Explain what is meant by the maximum, average, and R.M.S. value of an alternating current.

What is the R.M.S. value of an alternating current having a perfectly symmetrical rectangular wave form and a maximum of one amp? How would the heating effect of this current compare with that of a direct current having a steady value of 0·5 amp.?

7. What are the principles of heterodyne reception? Describe how a 500 cycle per second note can be heard in the telephones of a direction finder receiver when receiving continuous wave signals transmitted from a radio beacon on a frequency of 300 kilocycles per second.

8. A directional aerial system consisting of a vertical and loop aerials gives an output voltage $e = Ev\ (1 - \cos\theta)$ where Ev is the E.M.F. induced in the vertical aerial and θ is the angle between the plane of the loop and the direction of incident wave. Plot the polar diagram of the system and express in decibels the aerial gain of the system relative to the vertical aerial.

Theoretical Naval Architecture and Hydrostatics

Paper 8—(Three Hours)

N.B. Candidates are not to answer more than 6 questions.

1. A loaded vessel, 392 ft. long, 10,000 tons displacement, is to dry dock to repair stem damage. She is to take the blocks fore and aft but remain partly waterborne. If the initial GM is 2 ft., ITM 1,200 ft. tons, assuming a KM of 27 ft. and CF 4 ft. forward of midships estimate the maximum trim by the stern allowable if she is to have a positive virtual GM of 3 in. when taking the blocks all fore and aft.

2. The after bulkhead of a ballast tank is constructed so that the top section forms a rectangle 2x ft. wide by x ft. deep and the lower section forms an isosceles triangle whose lowest point is 2x ft. below the top of the tank. Evolve an expression for the distance of the centre of pressure of the bulkhead, below the top, in terms of x when the tank is just full.

3. Show that for a vessel which is wall sided in the vicinity of the water line, $GZ = (GM + \frac{1}{2}\ BM\ \tan^2\theta)\ \text{Sin}\ \theta$ when heeled at the angle θ.

Use this formula to calculate the GM in the upright position for a vessel 200 ft. long, 24 ft. beam, and at 10 ft. draught which is found to loll over to an angle of 5°.

4. The period of a ship's roll is given by the expression $T = 2\pi\sqrt{\frac{k^2}{mg}}$, where T is the time of one complete double roll, k is the radius of gyration, m is the metacentric height and g the acceleration due to gravity. Discuss the use of this formula and state its limitations.

5. A box-shaped vessel 450 ft. long, 58 ft. beam, and floating at 25 ft. draught on even keel, has a compartment amidships 60 ft. long with a W/T centre line bulkhead extending the whole depth. Calculate the angle of heel caused by the vessel being bilged on one side abreast this bulkhead, the CG of the vessel being 22 ft. above the keel.

6. Show mathematically how the connection between GZ and GM is utilised to establish the origin of a stability curve.

7. A uniform rod of length 1, whose weight is negligible, rests horizontally with its ends supported and carries a movable weight w; the rod will break if the bending moment at any point is L. Prove that the least value of w which can break the rod is $\frac{4L}{1}$.

NAVIGATION AND NAVIGATIONAL AIDS

Paper 9—(Three Hours)

N.B. Candidates are not to answer more than 6 questions.

1. Calculate the limiting azimuth of a star if its altitude is 23° 16′ at this azimuth, with a rate of change of altitude of 7·5′ per minute of time.

2. On 6 August 1958, the star Aldebaran is observed on the meridian and 2 hours 14 minutes 15 seconds later by chronometer the star Sirius is on the meridian. If the observer is moving along the parallel of latitude 43° N., find the course and speed.

3. Evolve a practical formula for finding the latitude by pole star observation.

4. (a) Describe clearly the difference between geocentric and geographical latitude.

(b) Calculate the geocentric latitude of a place whose geographical latitude is 36° 36′ N. (Compression $\frac{1}{293}$).

5. Explain carefully, with the aid of sketches, the following sextant corrections:

(a) Collimation error; (b) Sextant parallax.

6. Write notes on solar eclipses and ecliptic limits.

7. Describe a modern echo sounding machine capable of recording depths in either fathoms or feet.

8. Discuss intercardinal rolling errors as applied to a gyro compass."

T. J. SHERRARD,
Clerk of the Executive Council.

EXPLANATORY NOTE

This note is not part of the regulations, but is intended to indicate their general effect.

The effect of these regulations is to bring the standard pertaining to the examination for the certificate of competency as extra master into line with the requirements necessary for the obtaining of a similar certificate in the United Kingdom.

Issued under the authority of the Regulations Act 1936.
Date of notification in *Gazette:* 23 April 1958.
These regulations are administered in the Marine Department.