CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – MARINE ENGINEER OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 95 CHIEF ENGINEER REG. III/2 (UNLIMITED)

041-34 – NAVAL ARCHITECTURE

FRIDAY 22 MARCH 2013

0915 - 1215 hrs

Examination paper inserts:

Notes for the guidance of candidates:

1. Non-programmable calculators may be used.
2. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook
Graph paper

NAVAL ARCHITECTURE

Attempt SIX questions only

All questions carry equal marks

Marks for each part question are shown in brackets

1. A ship 102 m long floats at a draught of 6 m and in this condition the immersed cross sectional areas and waterplane areas are as given in Tables Q1(A) and Q1(B).
The *equivalent base area* (A_b) is required because of the fineness of the bottom shell.

Section	AP	1	2	3	4	5	FP
Immersed cross section area (m^2)	12	29	64	78	70	48	0

Table Q1(A)

Draught (m)	0	0.6	1.2	2.4	3.6	4.8	6.0
Waterplane area (m^2)	A_b	560	720	876	942	996	1028

Table Q1(B)

Calculate EACH of the following:

(a) the equivalent base area value A_b; (8)

(b) the longitudinal position of the centre of buoyancy from midships; (4)

(c) the vertical position of the centre of buoyancy above the base. (4)

2. A vessel has a depth of 12 m and a displacement of 10000 tonne when the metacentric height is 1.5 m and height to the metacentre (KM) is 7.8 m.

Two adjacent rectangular bunkers, extending over the full depth of the vessel, each 10 m long and 8 m wide, are situated either side of the centreline.

Each bunker is effectively full of fuel oil of density 900 kg/m^3.

Fuel is consumed from one bunker until a maximum angle of list of 3° is caused.

Calculate the maximum mass of fuel initially consumed before switching to the other bunker. (16)

Note: KM can be assumed constant.

3. The following particulars apply to a ship of 125 m length when floating in water of density 1025 kg/m^3 at an even keel draught of 6.425 m.

displacement	=	10850 tonne
centre of gravity above the keel (KG)	=	6.69 m
centre of buoyancy above the keel (KB)	=	3.57 m
waterplane area	=	1756 m^2
centre of flotation from midships (LCF)	=	2.5 m aft
second moment of area of the waterplane about a transverse axis through midships	=	1.526×10^6 m^4

(a) Calculate the moment to change trim by 1 cm (MCT 1cm). (4)

(b) The ship in the above condition now undergoes the following changes of loading:

50 tonne added with its lcg 27.5 m forward of midships
230 tonne removed with its lcg 2 m aft of midships
120 tonne moved 46 m aft.

Calculate EACH of the following for the new condition:

(i) the new end draughts of the ship; (9)

(ii) the longitudinal position at which a mass of 188 tonne should be added to restore the ship to an even keel draught. (3)

4. A box barge of 40 m length has a hull mass of 320 tonne evenly distributed over its length. Bulkheads located 2 m from the barge ends form peak tanks that remain empty.
The remainder of the barge length is divided by two transverse bulkheads into three holds of equal length.
A total of 960 tonne is loaded, one quarter of which is placed in the middle hold, the remainder being equally distributed over the two outer holds.

Draw, using graph paper, EACH of the following on a base of barge length:

(a) curves of weight and buoyancy per metre; (4)

(b) curve of loads; (3)

(c) curve of shearing forces; (4)

(d) curve of bending moments. (5)

5. A ship 135 m long displaces 13500 tonne. The shaft power required to maintain a speed of 16 knots is 5984 kW, and the propulsive coefficient based upon shaft power is 0.65.

wetted surface area = $2.6\sqrt{\Delta L}$
propulsive coefficient = ep/sp

Values of the Froude friction coefficient for Froude's Formula are given in Fig Q5, with speed in m/s and speed index (n) = 1.825

Calculate the shaft power for a geometrically similar ship which has a displacement of 18520 tonne and which has the same propulsive coefficient as the smaller ship, and is run at the corresponding speed. (16)

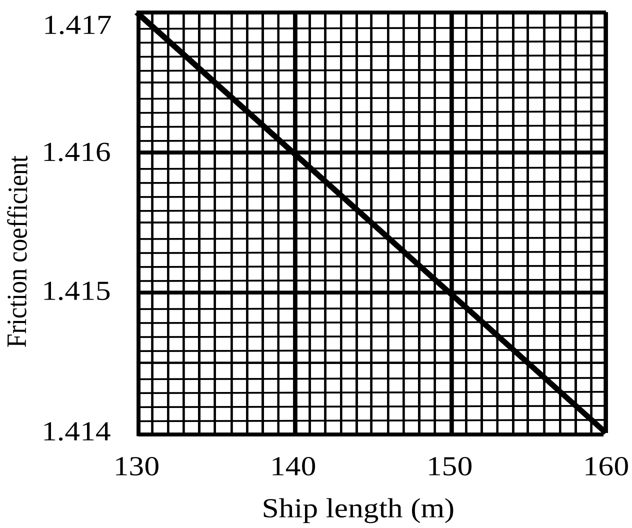

Fig Q5

6. A vessel of 9250 tonne displacement is fitted with a propeller of 6.0 m diameter and pitch ratio 0.85.

During a fuel consumption trial of 8 hours duration, a steady shaft speed of 1.75 rev/sec was maintained and 9.76 tonne of fuel was consumed.

The following results were also recorded:

real slip ratio	=	0.33
Taylor wake fraction	=	0.31
shaft power	=	5950 kW
transmission losses	=	3%
quasi-propulsive coefficient (QPC)	=	0.71
propeller thrust	=	645 kN

Calculate EACH of the following:

(a) the speed of the ship; (4)

(b) the apparent slip ratio; (1)

(c) the propeller efficiency; (3)

(d) the thrust deduction fraction; (3)

(e) the fuel coefficient; (3)

(f) the specific fuel consumption. (2)

7. (a) State FOUR disadvantages of mild steel as a material for ship construction. (4)

(b) Describe materials used as alternatives to mild steel, to overcome some of the disadvantages stated in Q7(a), stating examples of their possible application. (12)

8. (a) Describe, with the aid of a sketch, the influence on a statical stability curve of EACH of the following:

(i) an increase in the breadth of the ship, with the draught, freeboard and KG remaining constant; (5)

(ii) an increase in the freeboard of the ship, with the draught, breadth and KG remaining constant. (5)

(b) With reference to the statical stability curve, describe the minimum standards. (6)

9. (a) Sketch a modern oil tanker midship section of double hull construction. (8)

(b) Describe the advantages and disadvantages of this type of construction. (8)