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, 16 OCTOBER 2015

0915 - 1215 hrs

Examination paper inserts:

Worksheet Q3

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 floats at a draught of 10 m in sea water of density 1025 kg/m^3. In this condition the centre of gravity is 9.896 m above the keel and the second moment of area of the waterplane about the centreline is 94030 m^4.

   Values of tonne per centimetre immersion (TPC) in sea water are given in Table Q1.

Draught (m)	0	1	2	4	6	8	10
TPC	8.6	10.9	12.6	15.1	16.6	17.6	18.1

Table Q1

A load is to be discharged from the ship's centreline by the ship's own heavy lift crane. The crane head is 12 m above the original centre of gravity of the load and 16 m from the centreline of the ship when swung out. During the discharge it is required that the metacentric height should not be less than 1.75 m.

Calculate EACH of the following:

(a) the maximum load the crane may lift; (14)

(b) the angle to which the ship will heel when discharging the maximum load. (2)

2. (a) Sketch and label a statical stability curve for a vessel with its centre of gravity on the centreline but having a negative metacentric height when in the upright condition. (3)

(b) The ordinates for part of a statical stability curve for a bulk carrier at a displacement of 18000 tonne are given in Table Q2.

Angle (degrees)	0	10	20	30	45	60
Righting lever GZ(m)	0	0.447	0.983	1.396	1.627	1.467

Table Q2

The ship has a hold 40 m long and 30 m wide which contains bulk grain stowed at a stowage rate of 1.25 m^3/tonne.

During a heavy roll, the grain shifts so that the level surface is lowered by 1.5 m on one side and raised by 1.5 m on the other side.

(i) Draw the amended statical stability curve for the ship. (12)

(ii) From the curve, determine the angle of list due to the cargo shift. (1)

3. A ship 120 m long floats at draughts of 6.6 m aft and 4.2 m forward when floating in river water of density 1008 kg/m^3.

Using the hydrostatic curves provided in Worksheet Q3, determine EACH of the following:

(a) the displacement; (8)

(b) the longitudinal position of the centre of gravity. (8)

4. A box shaped vessel is 80 m long, 10 m wide and floats at an even keel draught of 4 m in water of density 1025 kg/m^3 with a KG of 3.43 m.

A full width empty compartment at the forward end of the vessel is 10 m long and has a watertight flat 2.5 m above the keel.

This end compartment is now bilged above the flat only.

Calculate the new end draughts of the vessel. (16)

Note: The KB in the bilged condition may be taken as half the new mean draught.

5. A ship of length 156 m and breadth of 24 m floats at a draught of 8.25 m in sea water of density 1025 kg/m^3. In this condition the block coefficient (C_b) is 0.72.

A geometrically similar model, 6 m in length, gives a total resistance of 43.55 N when tested at a speed of 1.65 m/s in fresh water of 1000 kg/m^3 at a temperature of 12ºC.

The following data are also available:

Ship correlation factor 1.23
Temperature correction $\pm$ 0.43% per ºC
Frictional coefficient for the model in water of density 1000 kg/m^3 at 15ºC is 1.655
Frictional coefficient for the ship in water of density 1025 kg/m^3 at 15ºC is 1.411
Speed in m/s with index (n) for ship and model 1.825

Wetted surface area (S) = $2.57\sqrt{\Delta L}$ (m^2)
QPC = 0.72

Calculate the delivered power of the ship at the speed corresponding to the model when the ship is travelling in sea water of density 1025 kg/m^3 at a temperature of 15ºC. (16)

6. The following data apply to a ship travelling at 17 knots:

propeller speed	1.85 revs/s
propeller pitch ratio	0.95
real slip ratio	0.34
Taylor wake fraction	0.30
torque delivered to the propeller	480 kNm
propeller thrust	640 kN
quasi-propulsive coefficient (QPC)	0.71
transmission losses	3%
fuel consumption per day	28 tonne

Determine EACH of the following:

(a) the apparent slip ratio; (4)

(b) the propeller diameter; (2)

(c) the propeller efficiency; (4)

(d) the thrust deduction fraction; (4)

(e) the specific fuel consumption. (2)

7. (a) List SIX hazards that arise with the carriage of liquefied gas in bulk. (6)

(b) Describe, with the aid of a sketch, the details of construction of a free standing prismatic tank within a gas carrier designed to carry liquefied petroleum gas (LPG). (10)

8. (a) With reference to ship hull vibration, define EACH of the following terms:

(i) frequency; (1)

(ii) amplitude; (1)

(iii) node; (1)

(iv) anti-node; (1)

(v) mode. (1)

(b) Define the term *resonance*, explaining its significance with respect to ship vibration. (4)

(c) State THREE adverse effects of ship vibration. (3)

(d) State FOUR sources of ship vibration. (4)

9. (a) Describe, with the aid of a sketch, a set of lifeboat gravity davits. (9)

(b) List the launching procedure associated with the davits described in Q9(a). (7)