SEAGOING ENGINEER OFFICER CLASS 2

CERTIFICATE OF COMPETENCY

NAVAL ARCHITECTURE

Time allowed: 3 hours

INSTRUCTIONS:-

This paper consists of NINE questions where

Candidates are required to attempt ANY SIX questions.

All questions carry equal marks.

Pass marks: 50 %

CANDIDATES ARE NOT ALLOWED TO WRITE ON OR DEFACE THIS PAPER

This paper consists of this page and FOUR other printed pages.

Notes to Candidates:-

i) Write down your name in the top right-hand corner on the first page of the answer sheets.

ii) Write down the question number in the top left-hand corner on each page.

iii) Answer each question on a new page.

iv) No need to copy the questions' details onto the answer sheets.

v) Switch off all your mobile phones and communication devices when in the examination room.

vi) Return all the question paper(s), the used and unused answer sheets before leaving the examination room.

vii) Do not disturb other candidate(s) in the examination room.

viii) Do not attempt to take any photos or recordings of any question papers and/or answer sheets.

ix) The progress of the examination is being recorded by close-circuit television (CCTV) and voice recorders in the examination room.

If the above rules from item v) to viii) are infringed, candidates will be regarded as having failed the examination as a whole and will not be accepted for re-examination for such period as may be decided by the Director.

考生注意事項：-

i) 在答題紙首頁右上角寫上姓名。

ii) 在每頁答題紙的左上角標明回答的問題題號。

iii) 每一條問題另開新頁作答。

iv) 不需要抄寫問題到答題紙上。

v) 進入試場後，把手機及所有通信設備關閉。

vi) 離開試場前，交回所有試卷、所有用過和未用過的答題紙及草稿紙。

vii) 試場內不可干擾其他考生。

viii) 切勿嘗試拍攝或錄取任何試卷或答案。

ix) 考試期間試場內會有閉路電視(CCTV)和錄音系統進行記錄。

如果違反上述 v) 至 viii) 規則，即當作所有考試不及格，以及在處長決定的期間內不得重考。

1. A single screw vessel is fitted with a propeller 4.3 m diameter, which when running at 120 rev/min gives a ship speed of 16 knots.

If the real slip ratio is 33% and the apparent slip ratio is 8%, calculate the pitch, Taylor wake fraction, pitch angle and slip angle.

2. The following information was obtained from the trials of a ship 120 m in length and 12,500 tonne displacement :-

Ship speed (knot)	14	15	16	17
Shaft power (kW)	2,550	2,850	3,270	3,880

(a) Draw on the same graph, curves of 'Admiralty Coefficient' and 'shaft power' to a base of 'speed/length ratio' $V/\sqrt{L}$; and

(b) Estimate the shaft power required for a similar ship 160 m in length and 19,400 tonne displacement when travelling at 17 knot.

3. A ship 165 m in length, 9.2 m breadth, floats in water of density 1,025 kg/m^3. The ship's areas of immersed sections are defined by the following equidistant intervals commencing from the after perpendicular (AP):

Station	AP	1	2	3	4	5	6	7	8	9	FP
Areas of immersed sections (m^2)	0	110	192	247	270	275	275	261	220	124	0

Calculate:

(a) the displacement; and

(b) the prismatic coefficient.

4. A barge of 165 m length, 23.2 m breadth and draught 9.2m has a displacement 24,300 tonne. A compartment is later added to give a new displacement of 30,000 tonne. Calculate:

(a) the prismatic coefficient before conversion; and

(b) the prismatic coefficient after conversion.

Coefficient of mid-ship cross-section before conversion is 0.96.

5. A hold pillar supports a deck area of 45 m^2. The deck supports cargo which stows at 0.5 tonne/m^2 and the pillar has a hollow cross section with an inside diameter which is three quarters the outside diameter.

Calculate the diameters of the pillar if the compressive stress in the material is not to exceed 320 MN/m^2. A safety factor of 5 is to be added.

6. A ship of 2,780 tonne displacement floating at a draught of 4.27 m has the following particulars:

KB = 2.5 m, KG = 6.5 m, BM = 5.65 m and TPC = 7.

Determine the change of metacentric height when a mass of 154 tonne, KG = 11 m is added to the vessel, assuming that the vessel is "wall-sided" over the change of draughts.

7. A barge of length 22 m, breadth 6m and depth 2.5 m has a flat bottom with vertical sides and ends. The shape in plan is of two semi-circular ends joined by straight parallel sides. The barge comprises of a hold consisting of the rectangular section with the two semi-circular portions as separate watertight compartments.

The barge floats at a draught of 1.4 m in water of density 1,025 kg/m^3, the centre of gravity of the barge and cargo being 1.5 m above the keel.

(a) Calculate the effective metacentric height after water of density 1,000 kg/m^3 is added to both end compartments to a depth of 2 m; and

(b) If part of the cargo of mass 10 tonne is moved from the centre of the barge through a distance of 2 m to one side, calculate the angle of heel.

8. A box shaped barge 36 m long, 6 m wide floats at a draught of 1 m in water of density 1,025 kg/m^3. The barge is divided into nine equal size watertight compartments by two transverse and two longitudinal bulkheads.

If the initial metacentric height is 1.2 m, calculate:

(a) the final GM when the central compartment is bilged,

(b) the angle of heel if a mass of 5 tonne is then moved vertically up 3 m and transversely 2 m.

9. With reference to crude oil carriers:

(a) Explain the following terms:

(i) segregated ballast tanks (SBT);

(ii) clean ballast tanks (CBT); and

(iii) protective locations (PL),

(b) (i) Explain the crude oil washing (COW) system for cargo tank cleaning; and

(ii) State the advantages of crude oil washing.

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