SEAGOING ENGINEER OFFICER CLASS 1

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 tank bulkhead is supported by vertical stiffeners which are spaced 1/10 of the bulkhead height apart. The stiffeners are attached to the bottom shell plating by brackets 700 mm wide connected to the shell by welding on both sides of brackets having throat thickness 6 mm. When the tank is filled to the top edge, on one side only, with sea water of density 1,025 kg/ m^3, the maximum shear force on the stiffeners is 240 kN.

Calculate :

(a) the height of the bulkhead;

(b) the shear force at the top;

(c) the position of zero shear; and

(d) the stress in the welds of the bottom bracket connection.

2. A mass of 10 tonne shifted transversely through a horizontal distance of 15 m produces an angle of heel of 5^O in a ship when its displacement is 5,400 tonne. The ship then loads the following items :

cargo (holds)	7,500 tonne with KG 8 m above keel
cargo (tween decks)	2,500 tonne with KG 12.8 m above keel
stores	150 tonne with KG 14.0 m above keel
oil fuel (SG 0.8)	250 tonne with KG 2.4 m above keel

In an oil fuel tank there is a free surface 12 m long by 12 m wide.

Calculate the virtual metacentric height in this loaded condition assuming the transverse metacentre remains at a constant height of 10 m above the keel.

3. A ship 85 m long displaces 8,100 tonne when floating in sea water at draughts of 5.25 m forward and 5.55 m aft. TPC 9.0, GM_L 96 m, LCF 2 m aft of midships.

It is decided to introduce water ballast to completely submerge the propeller and a draught aft of 5.85 m is required. A ballast tank 33 m aft of midships is available.

Find the least amount of water required and the final draught forward.

4. A ship of 15,000 tonne displacement has KG = 2.8 m, GM = 2.0 m, and KB = 2.5 m. Her rudder with an area of 18 m^2 is turning on the axis of the rudder post. The centre of pressure of the rudder is 1.35 m from the turning axis and 2.4 m above the keel plate.

If the ship is designed for a maximum ship speed of 14.5 knots, find :

(a) the diameter of the rudder stock, taking maximum allowable stress of 77 MN/ m^2 for steel; and

(b) the angle of heel when the ship is turning at rudder maximum angle with a turning radius of 200 m.

It can be assumed that : $F = 580\ Av^2$

where F = force acting on rudder parallel to centre line of ship, (N)

A = rudder area (m^2)

v = ship's speed (m/s).

5. A propeller with a 6 m diameter has a pitch ratio of 0.9, Blade Area Ratio 0.48 and, when turning at 110 rpm, has a real slip of 25% and wake fraction of 0.30. If the propeller delivers a thrust of 300 kN and the propeller efficiency is 0.65, calculate the following:

(a) the blade area;
(b) ship speed;
(c) thrust power;
(d) shaft power; and
(e) torque.

6. A ship of 8,000 tonne displacement has its centre of gravity 4.5 m above the keel and transverse metacenter 5.0 m above the keel when a rectangular tank 7.5m long and 15m wide contains sea water. A mass of 10 tonne is now moved 12m across the deck. Calculate the angle of heel:

   (a) If there is no free surface water; and
   (b) If the water does not completely fill the tank.

7. The frictional resistance of a ship in fresh water at 3 m/s is 11 N/m^2. The ship has a wetted surface area of 2,500 m^2 and the frictional resistance is 72% of the total resistance and varies as speed$^{1.92}$. If the effective power is 1,100 kW, calculate the speed of the ship.

8. A ship 80 m long has equally-spaced immersed cross-sectional areas of 0, 11.5, 27, 38.5, 44, 45, 44.5, 39, 26.5, 14.5 and 0 m^2 respectively. Calculate:

   (a) displacement of the ship;

   (b) distance of centre of buoyancy from midships; and

   (c) prismatic coefficient.

9. A ship has a length of 134 m and a speed of 16 knots. Determine:

   (a) the value of R_F if $\gamma = 1.19 \times 10^6$ and the wetted surface is 3170 m^2; and

   (b) the value of the Froude number *Fn*.

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