BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2012-2013

Sub : **NAME 447** (Design of Inland Waterways Transportation System)

Full Marks : 210                                    Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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### SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Classify inland waterways route of Bangladesh.                     **(15)**

   (b) Do you think that our inland waterways route needs re-classification? Justify your answer.                                                              **(20)**

2. (a) Mention some important functions of DoS, BIWTA and BIWTC.          **(15)**

   (b) Briefly discuss the conventional and advanced means to improve the energy efficiency of our inland waterways transport.                                  **(20)**

3. (a) Briefly discuss various constraints for the development of inland waterways transportation in Bangladesh.                                                **(20)**

   (b) Write short notes on the followings: (Any three)                  **(15)**

      (i) River tug

      (ii) Lighter barge

      (iii) House boat and

      (iv) Water bus

4. (a) Discuss important features of various types of research vessels.   **(15)**

   (b) With neat sketch distinguish between surface piercing and fully submerged type hydrofoils.                                                                 **(10)**

   (c) What is marine salvage? Briefly discuss different types of marine salvage suitable for inland waterways.                                                        **(10)**

### SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Mention the importance of hydrographic survey.                      **(10)**

   (b) Briefly discuss various methodologies for vertical depth measurements during hydrographic survey.                                                             **(15)**

   (c) What is "tidal survey"?                                            **(10)**

## NAME 447

6. (a) Distinguish between intermodal transport and multimodal transport. **(10)**

   (b) Describe intermodal transport chain. **(15)**

   (c) Discuss the factors affecting the growth of intermodal freight transportation. **(10)**


7. (a) Discuss various types of open-water disposal of dredged materials. **(10)**

   (b) Classify dredged sediments. What is the important features of this classification? **(10)**

   (c) Discuss some common techniques of dredging available at our inland waterways. **(15)**


8. (a) Discuss the merits and demerits of integrated tug-barge system over articulated tug-barge system. **(20)**

   (b) Draw the schematic view of the midship section of typical barge types on the basis of cargo carried. **(15)**

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2012-2013

Sub : **NAME 469** (Ship Performance)

Full Marks : 210                                        Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

Necessary diagrams are enclosed.

1. What are the basic principles of added resistance of ships in waves? In the light of Havelock's work, give a detail derivation for prediction of added resistance of a ship in regular head waves. Discuss what lapses are there in Havelock's method?                                        **(35)**

2. (a) What approach Maruo followed for prediction of added resistance of ships in waves? What are the components of added resistance Maruo obtained in his theory? Give a graphical representation of the components of added resistance and hence make you comments.                                        **(20)**

   (b) Describe how Beck placed Maruo's formula in a form that will allow evaluation of added resistance for any ship type.                                        **(15)**

3. (a) Describe analytically a simplified method for estimating speed loss at constant power and power increase at constant speed due to added resistance of a ship.                                        **(15)**

   (b) A ship is fitted with a 4-bladed propeller with a pitch-dia ratio of 0.8. The 5 m diameter propeller has an rpm of 180. The blade area ratio is 0.5. The ship speed is 16 Knot at calm water condition. The open water characteristics of the propeller is shown in the following diagram. Assume the wake fraction as 0.24. Construct a curve of

   $$\left(\cfrac{1}{1+\cfrac{\Delta\eta}{\eta_o}}\right) \text{ against } \left(1+\frac{\Delta R}{R_o}\right) \text{ and hence, determine the speed loss at constant power and}$$

   power increase at constant speed due to 15% added resistance compared to calm water resistance. Given that n = 2. The symbols have meanings.                                        **(20)**

# NAME 469

4. (a) With a definition diagram, describe the equations of axial force, lateral force and yawing moment of a ship experiencing an oblique wind in a seaway. **(15)**

(b) (i) Obtain curves of wind resistance, side force and yawing moment for a tanker of following dimensions: **(20)**

$$L = 220 \text{ m} \qquad C_B = 0.80$$
$$B = 34 \text{ m} \qquad A_T = 410 \text{ m}^2$$
$$T = 13 \text{ m} \qquad A_L = 1450 \text{ m}^2$$

(ii) Calculate the direct wind resistance for:

Ship's speed, V = 15 Knots

Ship's heading = 50° NE

True Wind speed = 15 m/sec

True Wind direction = − 45° NW and $\rho_{air}$ = 1.5 kg/m$^3$

(iii) Estimate the rudder resistance given that rudder area = 52 m$^2$ and rudder angle = 1°.

(iv) Estimate the yawing resistance if the yawing amplitude is 2.5°.

## SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

Symbols have their usual meaning. Assume reasonable value for any missing data.

5. (a) Define hull roughness. Why is outer hull condition important? Describe the steps for measuring hull roughness of a ship. **(15)**

(b) Explain the effects of following significant parameters on seakeeping performance of a ship: **(15)**

(i) Length

(ii) Draft

(iii) Freeboard and flare

(c) What is fouling? Mention some typical factors that influence the extent and severity of fouling on ship hull. **(5)**

6. (a) A cargo ship Propeller has following particulars: **(20)**

$$D = 5.5 \text{ m} , P/D = 0.865, N = 4 \text{ (Blade nos.)}$$

The roughness (μm) of blade section has been measured and given in the following Table

# NAME 469

Calculate APR considering the following weightage factor of propeller blade section-

| Region | Weight |
|--------|--------|
| 0.2-0.5 | 0.07 |
| 0.5-0.7 | 0.22 |
| 0.7-0.8 | 0.21 |
| 0.8-0.9 | 0.27 |
| 0.9-Tip | 0.23 |

(b) For measurement of propeller roughness reference to Q. No. 6(a), what methods are available for assessment? Discuss briefly. **(15)**

7. (a) A single screw medium speed cargo ship has the following particulars: **(30)**

$L_{WL} = 136$ m      $L_{BP} = 133$ m      $B = 19.5$ m

$T = 6$ m      $\Delta = 8776$ m$^3$      $C_B = 0.552$

$C_P = 0.576$      $C_m = 0.957$      $C_{wp} = 0.670$

Wetted area $= 2839$ m$^2$      $V = 15$ Knot

Hull roughness 260 μm

Days out of dock = 182.5 days

Added resistance due to wind and wave in a sea state 5 are 48.965 kN and 42.63 kN respectively. Total clean hull resistance 314.73 kN where hull roughness was considered 70 micron.

Find:

(i) Total resistance of the ship including fouling and hull roughness. Use ITTC formulation for calculating friction factor.

(ii) Using modified Townsin formula, calculate $\Delta C_F$, where AHR $= 150$ μm , $\gamma = 1.004 \times 10^{-6}$ m$^2$/s (water)

(b) List ten seakeeping aspects that need to be considered by the designer in the early design stage of a ship. **(5)**

8. Write short notes on : **(35)**

(i) Speed loss of ship

(ii) Voyage analysis and in-service monitoring

(iii) Seakeeping polar diagram

(iv) FR coatings

(v) CPD and SPC

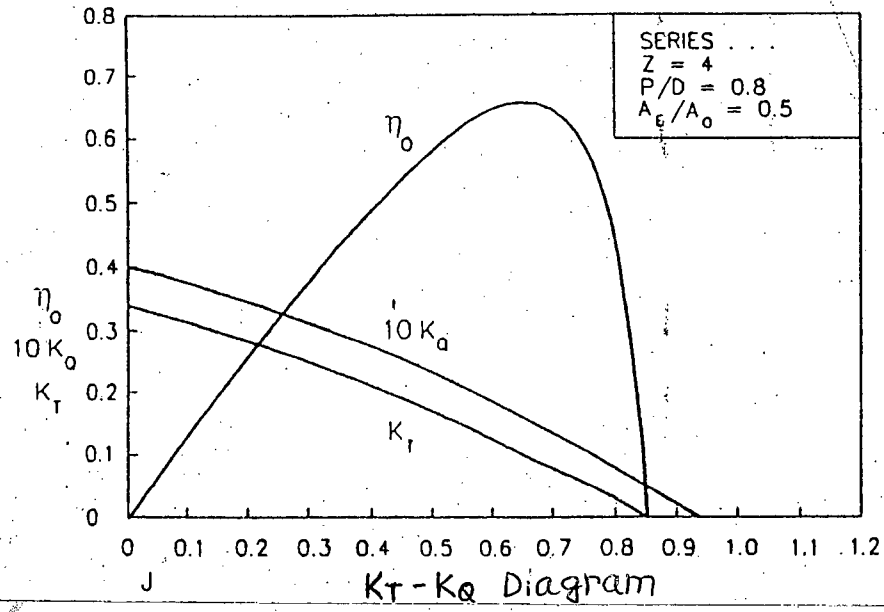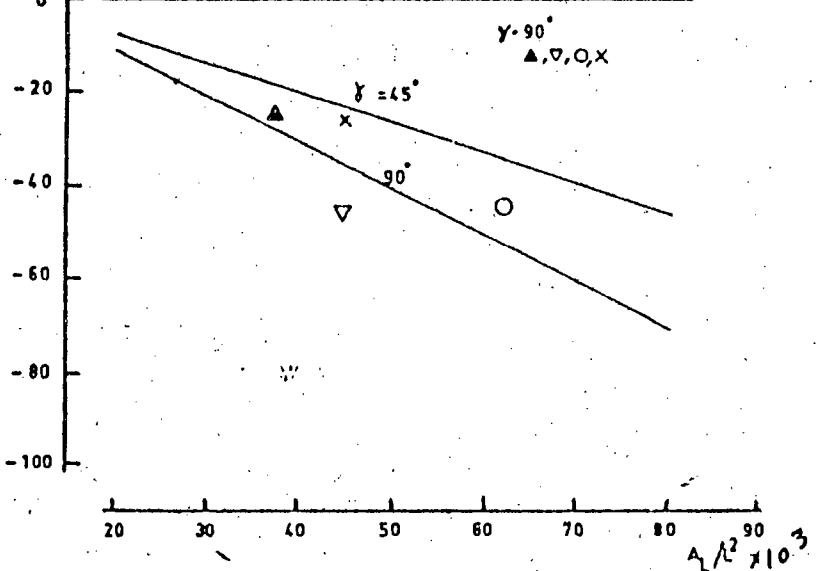---------------------------------

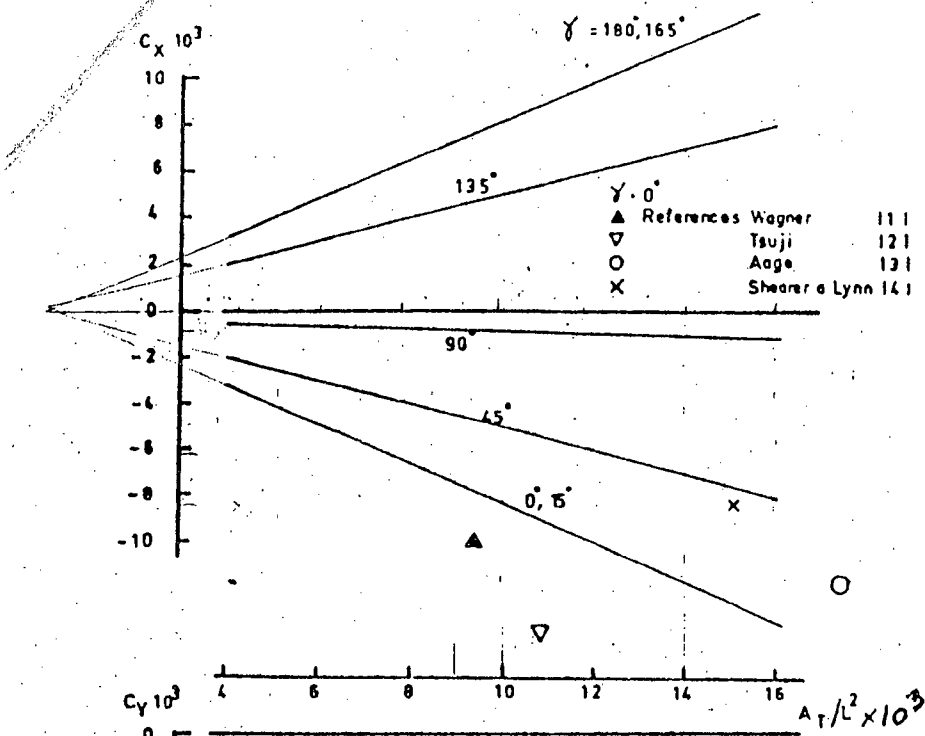SERIES . . .
Z = 4
P/D = 0.8
$A_E/A_0$ = 0.5

$\eta_0$

$10 K_Q$

$\eta_0$
$10 K_Q$
$K_T$

$K_T$

0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

0  0.1  0.2  0.3  0.4  0.5  0.6  0.7  0.8  0.9  1.0  1.1  1.2

J

$K_T - K_Q$ Diagram

$C_X 10^3$

$\gamma = 180, 165°$

135°

$\gamma \cdot 0°$
▲ References Wagner   [1]
▽ Tsuji   [2]
○ Aage   [3]
✕ Shearer a Lynn   [4]

90°

45°

0°, 15°

$A_T / L^2 \times 10^3$

$C_Y 10^3$

$\gamma \cdot 90°$
▲, ▽, ○, ✕

$\gamma = 45°$

90°

$A_L^2 \times 10^3$

$C_N 10^3$

$\gamma \cdot 135°$
▲, ▽, ○, ✕

$\gamma$ 135°

90°

0°

$A_L / L^2 \times 10^3$
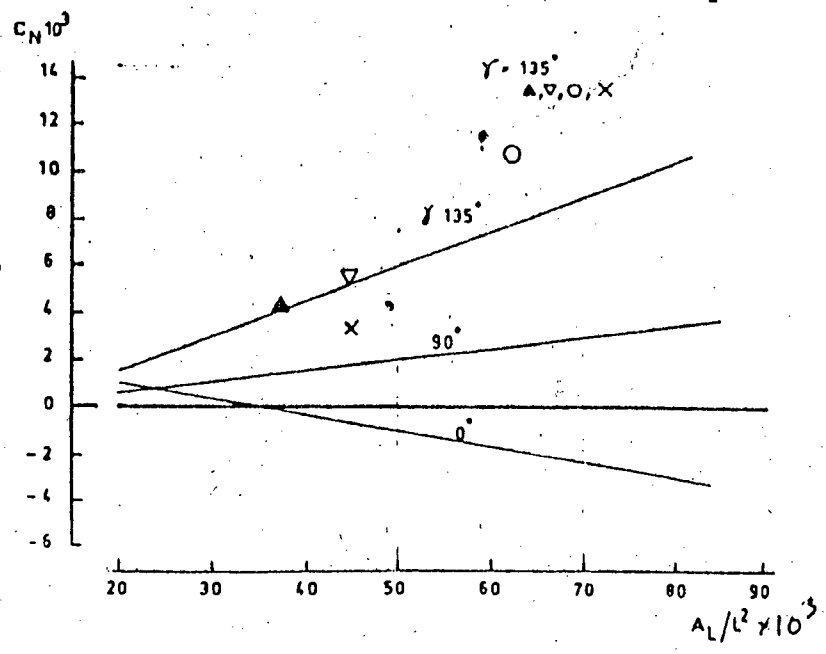
Fig. ----Level of wind coefficients for tankers

Face



Back

| Location | $R_a$ | $P_c$ | Location | $R_a$ | $P_c$ |
|----------|-------|-------|----------|-------|-------|
| 1 | 13.5 | 43 | 13 | 20.3 | 29 |
| 2 | 15.6 | 22 | 14 | 16.6 | 19 |
| 3 | 18.3 | 24 | 15 | 20.0 | 27 |
| 4 | 19.1 | 19 | 16 | 21.1 | 28 |
| 5 | 26.7 | 24 | 17 | 46.8 | 17 |
| 6 | 24.5 | 10 | 18 | 24.9 | 10 |
| 7 | 28.0 | 32 | 19 | 21.0 | 15 |
| 8 | 10.9 | 15 | 20 | 22.1 | 19 |
| 9 | 10.0 | 34 | 21 | 17.8 | 27 |
| 10 | 6.7 | 17 | 22 | 22.5 | 36 |
| 11 | 5.0 | 51 | 23 | 8.0 | 56 |
| 12 | 10.2 | 39 | 24 | 8.2 | 46 |

Table for Question No. 6(a)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2    B. Sc. Engineering Examinations 2012-2013

Sub : **NAME 449** (Navigation and Maritime Regulations)

Full Marks : 210                                         Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

Assume reasonable value in case of missing data.

1. (a) Discuss how international Maritime organization establishes a convention including the explanation of processes such as "Adopting a convention", "Entry into force", "Signature", "Accession", "Amendment" and "Enforcement". Discuss also how IMO operates to tackle the problem of marine pollution. **(25)**

   (b) What are the uppermost criteria of the 1966 Load Line Convention adopted by IMO? How are "Deck Line" and "Load Line Mark" to be represented according to the regulations of this convention? **(10)**

2. (a) A double skin segregated ballast crude oil tanker has the following particulars: **(28)**

   $L_{BP}$ = 223 m

   $L_{WL}$ = 230 m at 85% D

   B = 32.23 m

   D = 20.5 m

   Dead weight = 70000 tonnes

   Draft aft in ballast condition = 7.7 m

   Draft fore in ballast condition = 7.1 m

   Propeller diameter $D_P$ = 6.85 m

   Steel mass = 11371 MT

   Outfil mass = 1507 MT

   Engine plant mass = 822 MT

   From hydrostatic data,

   Displacement = 34000 MT at draft 6 m

   Displacement = 35800 MT at draft 7 m

   In addition, this tanker has 6 nos. of cargo oil tank with centerline longitudinal bulkhead dividing each tank port and starboard side.

   The total length of the cargo tank = 171 m

   Height of double bottom = 2.020 m

   Width of wing tank space = 2.1 m

   (i) Find the minimum SBT capacity in $m^3$ according to MARPOL if SBT contains salt water.

(ii) Estimate the abailable volume of ballast considering rectangular cross-sectional wing and double bottom tank. Comment whether the MARPOL requirements are fulfilled or not.

(iii) Suppose after side damage and bottom damage the corresponding hypothetical flows have been found $10160m^3$ and $500 \ m^3$ respectively. Is the limiting size and arrangement of cargo tank ok? Justify.

(b) According to the inland shipping ordinance of 1976, discuss the powers of surveyors and registers. **(7)**

3. (a) What are the effects of fatigue? What elements of shipboard fatigue can be influenced by the ship design process? **(18)**

(b) Discuss the pollution problem from oil cleaning operations. Discuss also the "Load on Top" and "Crude Oil Washing" process of cleaning oil tanks. **(10)**

(c) What are the regulations covered in the Hong Kong convention with regard to recycling of ships? **(7)**

4. (a) According to the UN convention on the Law of the Sea, discuss (with figure) the various water areas and their significance. **(22)**

(b) Briefly mention the general requirements of the following Fire Fighting Equipments according to shipping Rules. **(13)**

(i) Fire Pumps (ii) Fixed $CO_2$ System.

## SECTION – B
There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) A ship leaves a position in latitude 49°00′ N, longitude 160°00′ W and steams 000° T for 90 miles, 090° T for 90 miles, 180T for 90 miles and 270° T for 90 miles. What is her find position? **(17)**

(b) Find the great circle distance and the initial course on a voyage from Vancouver to Hawaii between the positions 48°20′ N, 125°00′ W, and 21° 15′ N, 157° 25′ W. **(18)**

6. (a) Briefly describe different types of Buoys. **(17)**

(b) Differentiate between Lateral and Cardinal Buoyage system. Describe IALA Cardinal Marks. **(18)**

**NAME 449**

7. (a) What is RADAR? Draw a neat sketch of a basic radar system.                    **(15)**

   (b) With a block diagram, describe the components and summary of functions of a basic pulse-modulated radar system.                    **(20)**

8. (a) Give a short description of 'Global Positioning System' and its major segments.                    **(17)**

   (b) Discuss the types of LORAN accuracy an the limitations of LORAN system.                    **(18)**

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2    B. Sc. Engineering Examinations 2012-2013

Sub : **NAME 429** (Marine Engineering)

Full Marks: 210            Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

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## SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Assume reasonable values for any missing data.

1. (a) Describe, with the help of schematic and p-h diagrams, the working principle of a two-stage vapour compression system with water intercooler, liquid sub-cooler and flash intercooler. **(15)**

   (b) The capacity of a refrigerator is 150 TR when working between –8°C and 23°C. Determine the mass of ice produced per month from water at 23°C. Also find the power required to drive the unit. Assume that the cycle operates on reversed Carnot cycle and latent heat of ice is 335 kJ/kg. **(10)**

   (c) What are the major differences between a refrigerator and a heat pump? How can you derive the E.P.R. of a heat pump from the C.O.P. of a refrigerator. **(10)**

2. (a) A vapor compression refrigeration machine, with Freon-12 as refrigerant, has a capacity of 12 tonne of refrigeration operating between –28°C and 26°C. The refrigerant is subcooled by 4°C before entering the expansion valve and the vapour is superheated by 5°C before leaving the evaporator. Determine– **(20)**

        (i)    Theoretical power required

        (ii)   C.O.P.

   The following properties of Freon-12 may be used:

| Sat. temp. °C | Pressure, bar | Sp. volume of vapour, m³/Kg | Enthalpy, kJ/Kg | | Enthalpy, kJ/Kg | |
|---|---|---|---|---|---|---|
| | | | Liquid | Vapour | Liquid | Vapour |
| –28 | 1.093 | 0.1475 | 10.64 | 175.11 | 0.0444 | 0.7153 |
| 26 | 6.697 | 0.0262 | 60.67 | 198.11 | 0.2271 | 0.6865 |

   Specific heat of liquid refrigerant = 0.963 kJ/Kg K and specific heat of superheated vapour = 0.615 kJ/Kg K.

   (b) Describe the effect of suction pressure and discharge pressure on a refrigeration unit. **(10)**

   (c) What are the major differences between the theoretical and actual vapour compression refrigeration cycle? **(5)**

3. (a) What do you understand by humidification and dehumidification? Describe the methods of obtaining humidification and dehumidification. **(10)**

(b) The mois air is heated by steam condensing inside the tube of a heating coil as shown in Fig. for Q. No. 3(b). The port of the air passes through the coil and part is by-passed around the coil. The barometric pressure is 1 bar. Determine– **(12)**

    (i)   The air per minute (in 3') which by-pass the coil.

    (ii)  The heat added by the coil.

(c) Describe the chemical properties of refrigerants. **(7)**

(d) What are the number of the following refrigerants? **(6)**

    (i)   Carbon dioxide

    (ii)  Mono chloro-penta fluoro-ethane ($CClF_2CF_3$).

4. (a) What is cooling load? Why is it necessary to estimate? Discuss the components of a cooling load. **(10)**

(b) Why duct design is so important? What are the duct materials? **(10)**

(c) A duct 2 m by 1 m in size carrying conditioned air runs in a straight line for 50 m from the supply fan. It divides into two parts each of 80 m long and 2 m by 1 m in cross-section as shown in Fig. for Q. No. 4(c). **(15)**

If the quantity of air discharged at C is 1600 $m^3$/min, calculate the quantity discharged at D and the static pressure at the fan outlet A. Calculate the duct friction loss in N/$m^2$ taking the value of friction factor as 0.005.

## SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is steam trap? Describe operating principle of different types of steam trap with figure. **(18)**

(b) Discuss the functions of anchor windlass and winch. **(17)**

6. (a) Write short notes on: **(1)**

    (i)   Causes of pipe failure

    (ii)  Air-Water zoned air conditioning system

    (iii) Stern tube bearing.

(b) Discuss four most popular methods of controlling shaft alignment. **(14)**

7. (a) Describe the operating principle of centrifugal pump. **(5)**

(b) A rotodynamic pump, having the characteristic tabulated below, delivers water from a river at elevation 102 m to a reservoir with a water level of 135 m, through a 350 mm diameter cast-iron pipe. The frictional head loss in the pipeline is given by $h_f = 555\ Q^2$, where $h_f$ is the head loss in m and Q is the discharge in $m^3s^{-1}$ Minor head losses from valves and fitting amount to $55\ Q^2$ in the same units. **(30)**

| $Q\ (m^3s^{-1})$ | 0 | 0.05 | 0.10 | 0.15 | 0.20 |
|---|---|---|---|---|---|
| H (m) | 60 | 58 | 52 | 41 | 25 |
| $\eta$ (%) | --- | 44 | 65 | 64 | 48 |

Pump characteristics: Q is discharge, H is head, $\eta$ is efficiency.

Calculate:

  (i) Discharge and head in the pipeline at duty point.

  (ii) If the discharge is to be increased by the installation of a second identical pump, determine the unregulated discharge and head produced by connecting the pump in parallel and in series.

  (iii) Determine the power demand at the duty point in the case of parallel operation.

8. (a) What is the purpose of using hunting gear? Describe two ram hydraulic steering gear system. **(18)**

(b) Write down the testing of steering gear that must be done in port and prior to departure. **(7)**

(c) Describe the following piping systems for ship: **(10)**

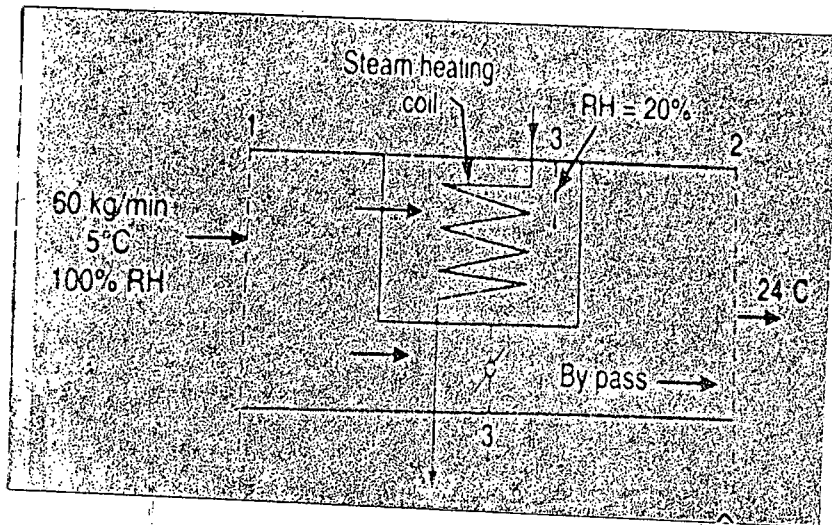  (i) Engine cooling system

  (ii) Hydraulic piping systems.

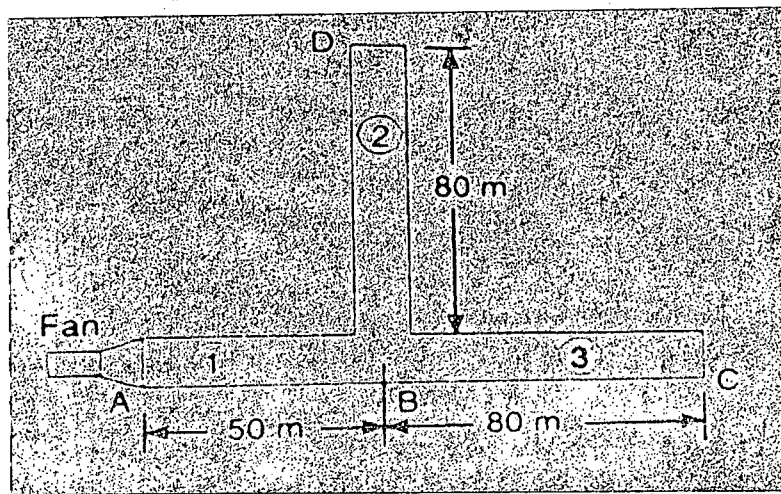----------------------------------

Figure for Q. No. 3(b)



Figure for Q. No. 4(c)

PSYCHROMETRIC CHART
NORMAL TEMPERATURE
SI Units

SEA LEVEL
BAROMETRIC PRESSURE: 101.325 kPa
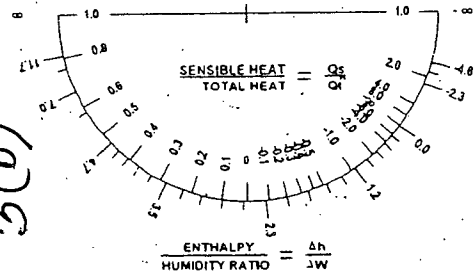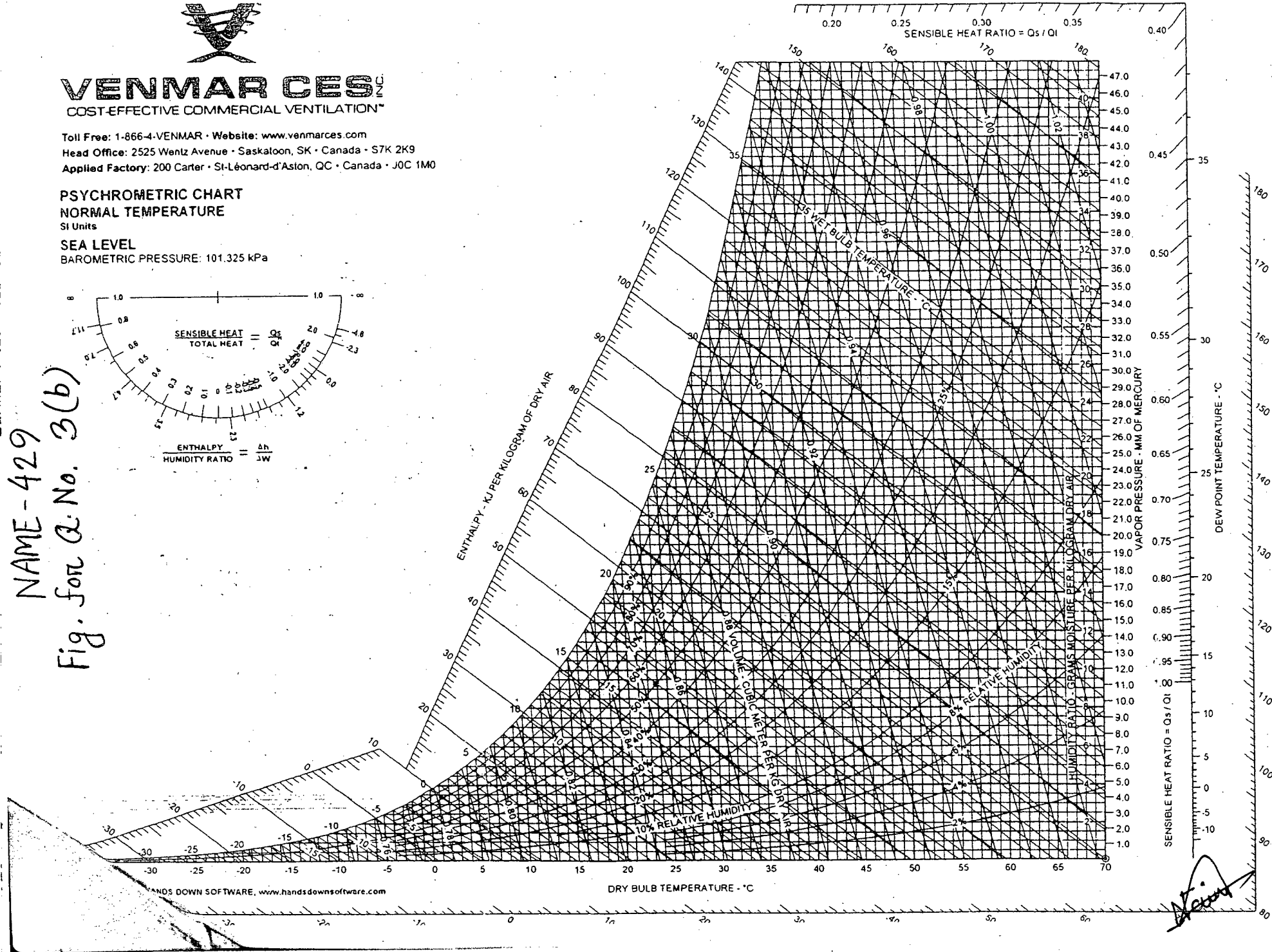
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NAME - 429
Fig. for Q. No. 3(b)

L-4/T-2/NAME                                    Date : 06/08/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2012-2013

Sub : **NAME 425** (Shipyard Management)

Full Marks : 210                          Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

The questions are of equal value.

1. (a) Cite Examples of Controversy that may occur in implementing the 'Specification' as mentioned in the contract agreement signed between Shipyard and Ship Owner. How can you improve the shipbuilding specification for better project management?

2. What is 'OFE' as used in Shipyard Management? What are the risks associated with them in regards time and cost of a Shipbuilding Project? Describe the precautionary measures that should be taken by a shipyard Manager to cover those risks.

3. 'Naval Architects should be Indemnified against Errors and Omissions' 'Design Completion Responsibility- Where Naval Architect?' Describe the above in the context of the role of Naval Architects in performing their duties for a shipyard.

4. How can 'Good Deeds' done by a Shipyard in executing Shipbuilding or Ship Repair Projects for the Ship Owner lead to 'Misdeed' for the Projects. Describe with examples. What measures the Shipyard Management should have taken to avoid such situations?

## SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

The figures in the margin indicate full marks.

5. (a) Write a short note on the ship types of the future and its influence on Shipbuilding Industry.                                                                                    **(15)**

   (b) With figure show the layout of a typical shipyard.                                **(20)**

6. (a) Mention the factors which influence the choice of site for a new shipyard.      **(15)**

   (b) Discuss the problems of siting a new shipyard. Identify and discuss three stages in the layout design process.                                                                    **(20)**

7. (a) With a flow chart demonstrate typical shipyard organization structure.          **(15)**

   (b) How planning and scheduling are important in respect of shipyard operations?    **(10)**

(c) "Not to advance is to fall behind" and to keep abreast of international competition the Shipbuilding industry and associated institution devote substantial effort in men and money in various research and development (R&D) activities. In view of this statement discuss the R&D activities of a large Shipbuilding organization. **(10)**

8. (a) Describe the different activities of the steel preparation shop. **(15)**

(b) What type of work is done in the fabrication shop? **(10)**

(c) Write short notes on: **(10)**

(i) Building Dock.

(ii) Dry Dock.

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-4/T-2    B. Sc. Engineering Examinations 2012-2013
Sub : **NAME 427** (Maritime System and Management)
Full Marks : 210                                   Time : 3 Hours
USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A
There are **FOUR** questions in this Section. Answer any **THREE**.
The questions are of equal value.
All symbols have their usual meanings. Assume suitable values for missing data if any.

1.  (a) Draw the conceptual diagram of slow speed and medium speed diesel as alternative machineries for Bulk carrier showing the items which make them different.
    (b) What are the typical sources of error that occur in techno economic comparison of alternative machinery systems.

2.  A 3000-tonne deadweight tanker brought by a shipwonwer for a total of £ 6 m cash. It is operated on a 15 years time charter at US$ 50.00 per tonne deadweight per month after commissions with zero residual value. The crew costs are £ 400,000 and uniform throughout the charter period and other operating costs are £ 455,000 per year with no escalation. Calculate NPV at 8.9% discount rate with corporation tax at 35% under tax system, declining balance at 25% (other profits available).

3.  Table 1 and Table 2 show respectively the Building Account and operating Account of a 100,000 cubic meter liquefied gas carrier. Operating in a consortium with a 12 year time charter. Do you think that the proposed charter will be profitable for the owner if he wants the rate of returns after tax of at least 12% in money terms? Support your answer with calculation. Show the calculation how further escalation clauses will improve the economic status of the charter.

4.  What are the principal and secondary parameters of a Marine Transport System? How can those parameters be expressed in more specific terms. Determine the expression for Annual Cash outflow of freight earning vessel, mentioning the meaning of the symbols of the input available used.

## SECTION – B
There are **FOUR** questions in this Section. Answer any **THREE**.
The figures in the margin indicate full marks.

5.  (a) Draw a figure for a number of broad categories of marine vehicles and also describe the relative importance of difference categories.                                              **(15)**
    (b) Find the present worth of the following cash flow using the rate of interest 10%.   **(20)**

**NAME 427**
**Contd ... Q. No. 5(b)**

| Year 1 | $ 100 |
| Year 2 | $ 50 |
| Year 3 | $ 0 |
| Year 4 | $ 100 loss |
| Year 5 | $ 200 |

6. (a) Describe the type of charter and the division of responsibility for cost and ship's time between Shipwoner and Charterer. **(20)**

(b) A package of control equipment for an item of ship's machinery comes in two models: a heavy duty model consting $ 40,000 which will last the 16-year life of the ship and a standard model costing $ 26,000 which last 8 years. Which model offers the lowest cost over the ship's life, if maintenance and operating costs are the same for both models? Assume 12% opportunity cost of capital. **(15)**

7. (a) deduce the following expression for series Compound Amount (SCA) factor: **(20)**

$$SCA = \frac{(1+i)^N - 1}{i}$$

(b) Find the average annual cost of a ship that has an investment cost of $ 6,000,000, a predicted resale value of $ 3,000,000 after 5 years, and operating cost as listed in the table below: The interest rate is 20%. **(15)**

| Year | 1 | 2 | 3 | 4 | 5 |
|------|-----|-------|-----|-----|--------|
| Operating cost (M : million) | $ 1M | $ 1.2 H | $ 3 M | $ 3 M | $ 3.2 M |

8. (a) Write short note on the following economic criteria: **(20)**

NPV, RFR, IRR and permissible price.

(b) Consider the following cash flow of a project.

| Year | 0 | 1 | 2 | 3 | 4 | 5 |
|------|---------|-------|-------|-------|-------|-------|
| Cash flow | − 10,000 | 4,000 | 4,500 | 5,000 | 5,500 | 6,000 |

Find the rate of return of the project. **(15)**

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# BUILDING ACCOUNT *(Table 1 for Q no 3)*

### Thousands of Dollars

| (1) Year | (2) Building Instalments | (3) Owner's 20% | (4) Loan Drawdown | (5) Owner's Expenses & Fees | (6) Loan Repayments | (7) Loan Outstanding | (8) Loan Interest 8% | (9) Owner's Cash Outflow | (10) Present Worth Factor | (11) DCF |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 5000 | 5000 | | | | | | | | |
| 0.5 | 10000 | | 10000 | 500 | | | | 5500 | 1.0000 | 5500 |
| 1 | 10000 | 5000 | 5000 | 500 | | 10000 | 0 | 500 | 0.9449 | 472 |
| 1.5 | 15000 | | 15000 | 500 | | 15000 | 400 | 5900 | 0.8929 | 5268 |
| 2 | 20000 | 5000 | 15000 | 500 | | 30000 | 600 | 600 | 0.8437 | 506 |
| 2.5 | 20000 | | 20000 | | | 45000 | 1200 | 6700 | 0.7972 | 5341 |
| 3 | 20000 | 5000 | 15000 | 1000 | | 65000 | 1800 | 1800 | 0.7533 | 1356 |
| 4 | | | | | | 80000 | 2600 | 8600 | 0.7118 | 6121 |
| 5 | | | | | 10000 | 70000 | 6400 | 16400 | 0.6355 | 10422 |
| 6 | | | | | 10000 | 60000 | 5600 | 15600 | 0.5674 | 8851 |
| 7 | | | | | 10000 | 50000 | 4800 | 14800 | 0.5066 | 7498 |
| 8 | | | | | 10000 | 40000 | 4000 | 14000 | 0.4523 | 6332 |
| 9 | | | | | 10000 | 30000 | 3200 | 13200 | 0.4039 | 5331 |
| 10 | | | | | 10000 | 20000 | 2400 | 12400 | 0.3606 | 4471 |
| 11 | | | | | 10000 | 10000 | 1600 | 11600 | 0.3220 | 3735 |
| | | | | | 10000 | 0 | 800 | 10800 | 0.2875 | 3105 |
| Total | 100000 | 20000 | 80000 | 3000 | 80000 | | 35400 | 138400 | | 74309 |

# OPERATING ACCOUNT  (Table 2 for Q no 3)

*Thousands of Dollars*

| (1) Year | (2) Annual Income | (3) Crew Costs | (4) Upkeep Costs | (5) Other Costs | (6) Annual Operating Costs | (7) Cash Flow Before Tax | (8) Tax Interest | (9) 25% Annual | (10) Max. Cum. | (11) Actual Annual | (12) Actual Cum. | (13) Total Tax Allowances | (14) Taxable Profit | (15) Tax at 35% | (16) Cash Flow After Tax | (17) Present Worth Factor 12% | (18) DCF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 22667 | 1200 | 1496 | 1702 | 4398 | 18269 | 13000 | 25750 | 25750 | 5269 | 5269 | 18269 | 0 | 0 | 18269 | 0.6355 | 11610 |
| 5 | 22667 | 1200 | 1616 | 1838 | 4654 | 18013 | 5600 | 19313 | 45063 | 12413 | 17682 | 18013 | 0 | 0 | 18013 | 0.5674 | 10221 |
| 6 | 22667 | 1200 | 1745 | 1985 | 4930 | 17737 | 4800 | 14484 | 59547 | 12973 | 30619 | 17737 | 0 | 0 | 17737 | 0.5066 | 8986 |
| 7 | 22667 | 1200 | 1885 | 2144 | 5229 | 17438 | 4000 | 10863 | 70410 | 13438 | 44057 | 17438 | 0 | 0 | 15115 | 0.4039 | 6105 |
| 8 | 20667 | 1200 | 2036 | 2315 | 5551 | 15115 | 3200 | 8147 | 78557 | 11915 | 55972 | 15115 | 0 | 0 | 16768 | 0.3606 | 6047 |
| 9 | 22667 | 1200 | 2199 | 2500 | 5899 | 16768 | 2400 | 6111 | 84668 | 14363 | 70340 | 16768 | 0 | 0 | 16392 | 0.3220 | 5278 |
| 10 | 22667 | 1200 | 2375 | 2700 | 6275 | 16392 | 1600 | 4583 | 89251 | 14792 | 85132 | 16392 | 7636 | 0 | 15986 | 0.2875 | 4596 |
| 11 | 22667 | 1200 | 2565 | 2916 | 6681 | 15986 | 800 | 3437 | 92688 | 7556 | 92688 | 8356 | 12969 | 2673 | 12874 | 0.2567 | 3305 |
| 12 | 22667 | 1200 | 2770 | 3150 | 7120 | 15547 | -- | 2578 | 95266 | 2578 | 95266 | 2578 | 9140 | 4539 | 6534 | 0.2292 | 1498 |
| 13 | 18667 | 1200 | 2991 | 3402 | 7593 | 11073 | -- | 1933 | 97199 | 1933 | 97199 | 1933 | 13112 | 3199 | 11363 | 0.2046 | 2325 |
| 14 | 22667 | 1200 | 3231 | 3674 | 8105 | 14562 | -- | 1450 | 98649 | 1450 | 98649 | 1450 | 12922 | 4589 | 9421 | 0.1827 | 1721 |
| 15 | 22667 | 1200 | 3489 | 3968 | 8657 | 14010 | -- | 1088 | 99737 | 1088 | 99737 | 1088 | 26737 | 4523 | 25477 | 0.1631 | 4155 |
| 16 | 30000 | | | | | 30000 | | | | +3263 | 103000 | 3263 | | 9358 | -9358 | 0.1456 | -1362 |
| 17 | | | | | | | | | | | | | | | | | |
| Total | 296002 | 14400 | 28398 | 32294 | 75092 | 220910 | 35400 | | | | 103000 | 138400 | 82516 | 28881 | 192029 | | 72371 |