

PAPER: TERRESTRIAL & CELESTIAL NAVIGATION

PART - A

- Q.1 Chart work problems (25 marks)
- Q.2 Chart work problems (25 marks)
- Q.3 Execution of passage plan. (25 marks)



* If VSA is given,

$$\text{Distance off in NM} = \frac{\text{Ht of lt house} \times 1.854}{\text{VSA in minutes (include 15 also)}}$$

* LHO characteristics

FL 35 (46m) (23 M)
 ↓
 46 meter → 23 Miles

* To find luminous range, get nominal range from chart (M) & visibility given in question.

Find luminous range, using luminous range diagram

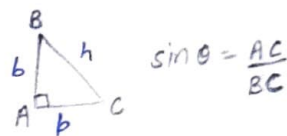
To find Nominal range:- $2.095(\sqrt{h} + \sqrt{H})$

h = height of eye

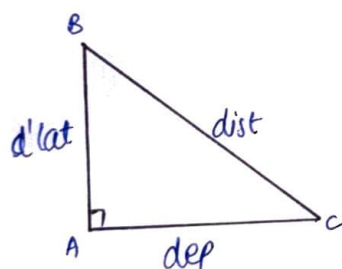
H = height of lighthouse (m)

* pandit badri prasad
 hari hari bol

p b p
 h h b
 s c t



*



$$\sin \theta = \frac{p}{h}$$

$$\sin \theta = \frac{AC}{BC}$$

$$\sin \theta = \frac{dep}{dist}$$

$$\cos \theta = \frac{b}{h}$$

$$\cos \theta = \frac{AB}{BC}$$

$$\cos \theta = \frac{d'lat}{dist}$$

CHART 5072

① A vessel at anchor observes the following compass bearings:

a) Christianso (S) Lt Ho (55° 19' N, 015° 11' E) : 065° (C)

b) Svanke Lt Ho (55° 08' N, 015° 09' E) : 161° (C)

c) Hammerodde Lt Ho (55° 18' N, 014° 47' E) : 284° (C)

Find vessel's position and deviation on the ship's head. Variation 1° W

Sol:

Difference in the bearing

① Christianso Lt Ho & Svanke Lt house

$$HSA = 065^\circ \sim 161^\circ = 96^\circ$$

If the horizontal sextant angle θ is more than 90° , the complement of horizontal sextant angle is $\theta - 90^\circ$

$$= 96 - 90^\circ$$

$$= 6^\circ$$

② Svanke Lt ho & Hammerodde Lt house

$$HSA = 161^\circ \sim 284^\circ = 123^\circ$$

$$\text{compliment of HSA} = \theta - 90^\circ$$

$$= 123 - 90^\circ$$

$$= 33^\circ$$

Now start plotting

Step ① : Join all three Lt house from left to right, naming A, B & C

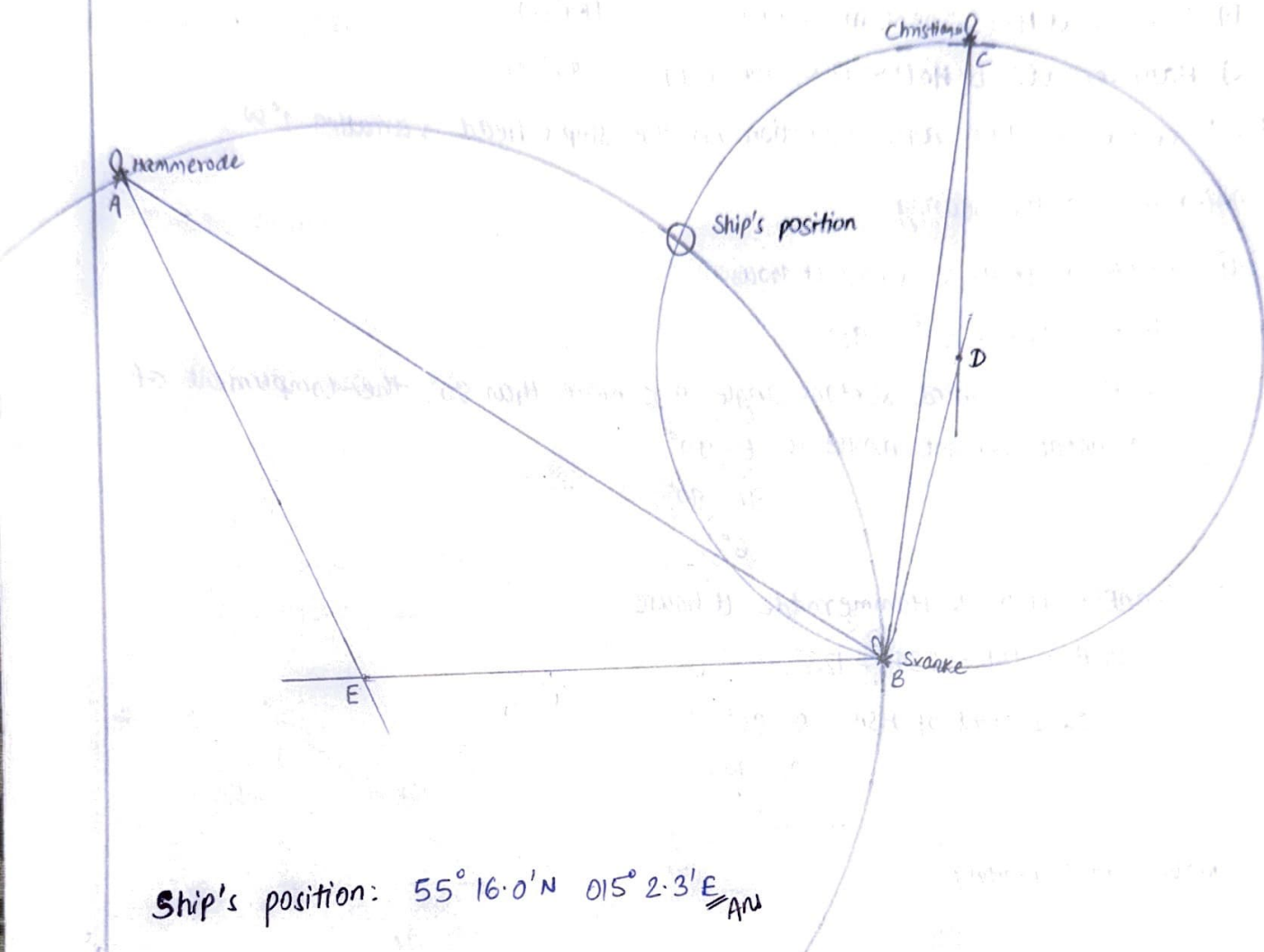
Step ② : Lay of angle 6° at Christianso & Svanke on the opposite side of the observer (bcz θ is more than 90°). The point where they intersect, name it D

Step ③ : Taking D as a centre, draw a circle passing through both the lighthouse

Step ④ : Lay of angle 33° at Svanke & Hammerode on the opposite side of the observer. The point where they intersect, name it E

Step ⑤ : Taking E as a centre, draw a circle passing both the lighthouse

Step ⑥ : Point where both circle intersect, that will be ship's position.

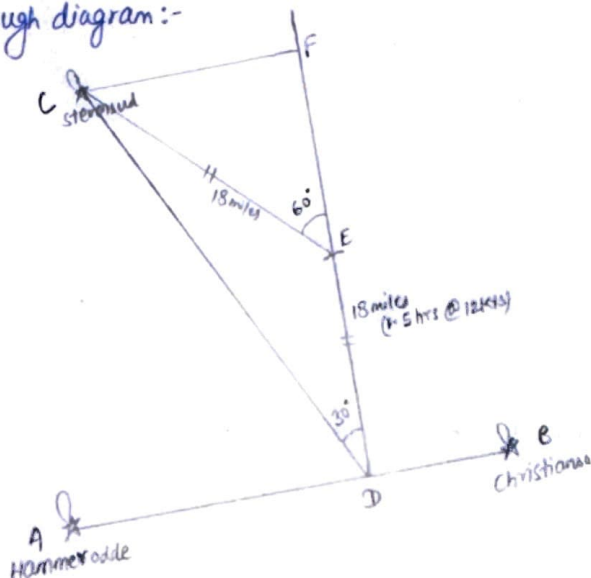


Ship's position: $55^{\circ} 16.0' N$ $015^{\circ} 2.3' E$ Ans

	Christianso	Svanke	Hammerode
Compass brg :	065°	161°	284°
True brg :	059°	155°	278°
CE :	$\overline{6^{\circ} W}$	$\overline{6^{\circ} W}$	$\overline{6^{\circ} W}$
variation :	$\overline{1^{\circ} W}$		
Deviation :	$\overline{5^{\circ} W}$ <u>Ans</u>		

- ② At 0800 hrs Hammerodde ($55^{\circ}18'N$, $014^{\circ}47'E$) and Christianso ($55^{\circ}08'N$, $015^{\circ}09'E$) lighthouses were observed on a reciprocal bearing line, same time Stensuvud lighthouse was observed 30° on Port bow, after 1.5 hrs of steaming at a speed of 12 Kts, same lighthouse was observed 60° on her port bow. Find position of the vessel and course steered by the vessel.

Solⁿ: Before plotting,
 since two vessels were on a reciprocal bearing line. vessel is somewhere between two lighthouse.
 Draw a rough diagram:-



In $\triangle CFE$,

$$\sin \theta^{\circ} = \frac{CF}{CE}$$

$$\sin 60^{\circ} = \frac{CF}{18}$$

$$CF = 18 \times \sin 60^{\circ} \\ = 15.588'$$

In $\triangle CFD$,

$$\sin \theta = \frac{CF}{CD} \Rightarrow \frac{P}{h}$$

$$\sin 30^{\circ} = \frac{15.588'}{CD}$$

$$CD = 31.176'$$

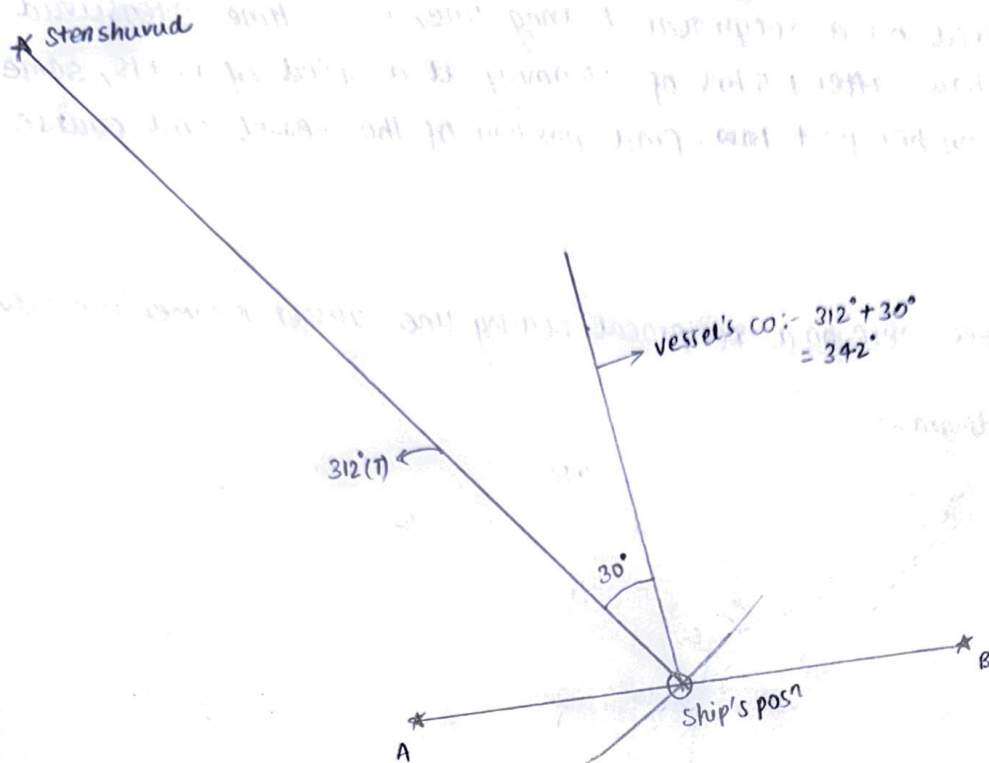
Now start plotting.

Step ① :- Join Hammerodde & Christianso, name it A & B

Step ② :- Take $31.176'$ arc & cut on line AB
 where it cut is vessel posⁿ

Ship's position:- $55^{\circ}18.5'N$ $014^{\circ}56.2'E$

step ③ :- Join stenshuvud & ship's position

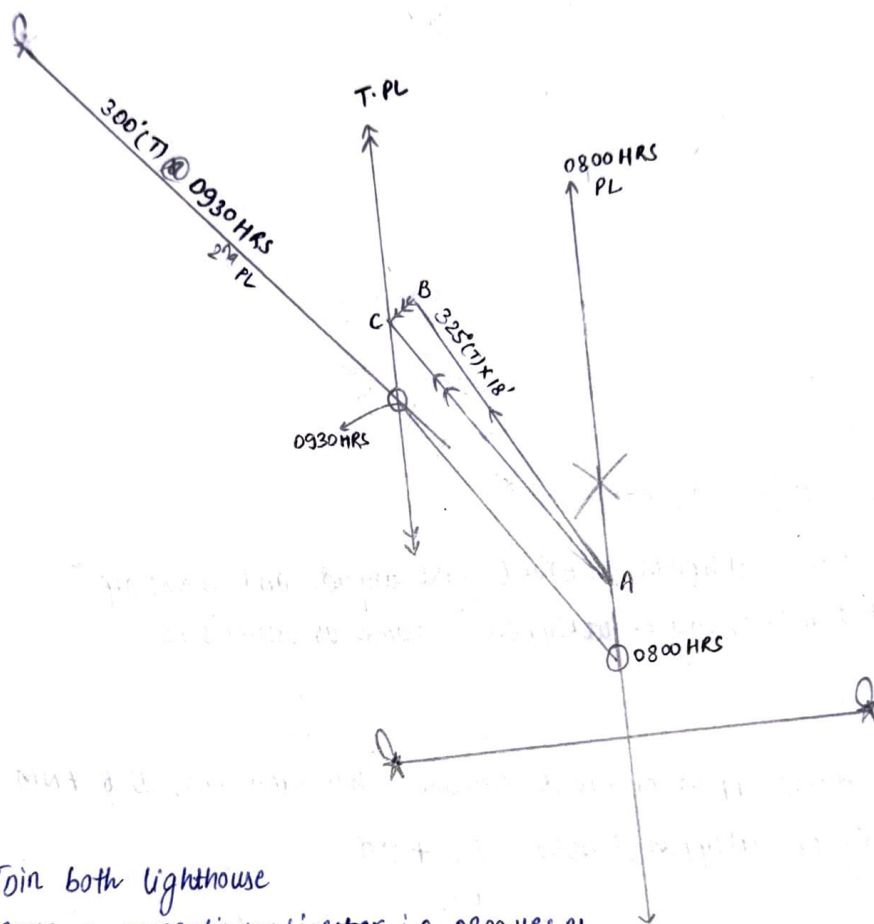


$$\begin{aligned}
 \text{Ship's course} &= \text{T. brg of stenshuvud} + 30^\circ \\
 &= 312^\circ + 30^\circ \\
 &= 342^\circ \\
 &= \underline{\underline{\text{Ans}}}
 \end{aligned}$$

MMD Question:- JAN 2025 AM (Q.2)
JULY 2024 AM
OCT 2016

- ③ At 0800 hrs a vessel was equidistant from Hammerodde ($55^{\circ} 18' N$, $014^{\circ} 47' E$) and Christianso Lt ($55^{\circ} 19.3' N$, $015^{\circ} 11.5' E$) houses. She was steering a course $325^{\circ}(T)$ at 12 Kts, current was estimated to set SW^W at 2 Kts. At 0930 hrs, Stensurud Lt House bore $300^{\circ}(T)$. Find the position of the vessel at 0800 hrs and 0930 hrs.

Soln:-



Step ①: Join both lighthouse

Step ②: Make a perpendicular bisector i.e. 0800 HRS PL

Step ③: Take any random point on 0800 HRS PL

Steer $325^{\circ} \times 18$ NM

From there, put current SW^W $\times 3$ m

Draw CMG

Step ④: Transfer 0800 HRS PL on Point C i.e. T.PL @ 0930 HRS

Step ⑤: Draw PL from Stensurud of $300^{\circ}(T)$

Step ⑥: Where both PL cuts i.e. posⁿ at 0930 hrs

Step ⑦: Shift CMG i.e. AC to posⁿ at 0930 hrs

Where it cuts at 0800 HRS PL

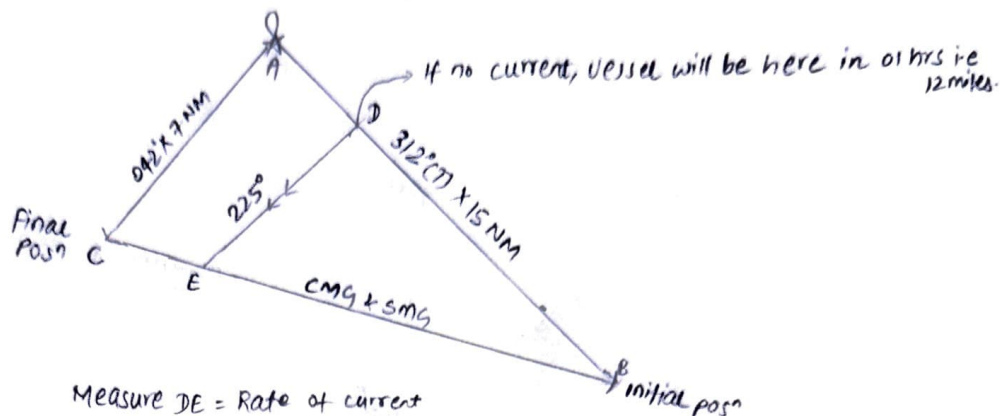
i.e. posⁿ at 0800 hrs

0800 HRS posⁿ: $55^{\circ} 21.0' N$ $014^{\circ} 58.9' E$

0930 HRS posⁿ: $55^{\circ} 3.0' N$ $014^{\circ} 36.0' E$

- ⑧ While steering a course $312^\circ(T)$ at 12 kts speed with current setting $225^\circ(T)$, at 1800 hrs UTKLIPPAN Lt ($55^\circ 57'N$, $015^\circ 41'E$) was observed right ahead and 15 NM off. Find position of the vessel while maintaining same course and speed, same Lt ho was observed abeam on her stbd side and abeam distance was 7 NM. Find the CMG, SMG, Time when Utklippan Lt ho will be abeam and Rate of current

Soln,



Given:- CO: $312^\circ(T)$

Spd: 12 kts

current setting: $225^\circ(T)$

At 1800 hrs, Utklippan observed right ahead and 15 NM off that means, brg of Utklippan is same as vessel's CO.

Step ①:- plot brg x mg ($312^\circ \times 15'$) & get posⁿ at 1800 i.e. B

At some point, Utklippan observed abeam on her stbd side, dist. 7 NM

$$\text{brg of Utklippan} = 312^\circ + 90^\circ = 042^\circ$$

Step ②:- plot brg x mg ($042^\circ \times 7'$) & get final posⁿ i.e. C

Step ③:- Join A & B.

Step ④:- On line AB, cut 12 NM arc i.e. D $\rightarrow$ VSL after 01 hrs, if there is no current

Step ⑤:- plot current i.e. $225^\circ(T)$ from point D

Step ⑥:- Measure DE i.e. Rate of current: 5.2 kts

Step ⑦:- Measure BE i.e. CMG & SMG

$$\left. \begin{array}{l} \text{CMG: } 284^\circ(T) \\ \text{SMG: } 13.1 \text{ kts} \end{array} \right\} \text{Ans}$$

Step ⑧:- Measure BC i.e. DMG

$$= 16 \text{ NM} \div 13.1 \\ \text{i.e. } 1 \text{H } 13 \text{M}$$

Time at Point C: 1800 + 01H 13M

when Lt ho is abeam

$$= 1913 \text{ HOURS} = \text{Ans}$$

At 0800 hrs, A vessel steering a course of $290^\circ(T)$, spd 12 kts observes forward of beam Christianso Is ($55^\circ 08'N$, $015^\circ 09'E$) to be 06 nm. At 0930 hrs it observes Simnisha Is WRG ($55^\circ 33.5'N$, $014^\circ 22'E$) to bear $310^\circ(T)$. If the current was setting $330^\circ(T)$ at 2 kts through out, find the position of the vessel at 0800 hrs.

The diagram illustrates the transfer of position and course information between two ships, SIMRISHAN and Christianso, based on radar observations.

Ships and Positions:

- SIMRISHAN:** Represented by a star symbol at the top left.
- Christianso:** Represented by a star symbol at the bottom right, labeled "A Christianso".

Observations and Transfers:

- 0930 posⁿ:** A position fix for SIMRISHAN, marked with a circle on a solid line.
- 0930 Transferred P.C.:** A position fix for Christianso, marked with a circle on a solid line.
- 0800 posⁿ:** A position fix for Christianso, marked with a circle on a solid line.
- 0800 6NM P.C.:** A position fix for Christianso, marked with a circle on a solid line.

Course and Distance Information:

- CMG & SMG 290° x 18 NM:** A dashed line representing the course and distance from Christianso to the 0800 posⁿ.
- Transferred CMG & SMG:** A dashed line representing the transferred course and distance from Christianso to the 0930 posⁿ.
- Not possible:** A label indicating that the transferred course and distance from Christianso to the 0930 posⁿ is not possible.
- possible:** A label indicating that the transferred course and distance from Christianso to the 0930 posⁿ is possible.

Other Labels:

- 0930:** A label near the 0930 posⁿ.
- 0800:** A label near the 0800 posⁿ.
- 0800 6NM P.C.:** A label near the 0800 posⁿ.
- 0930 Transferred P.C.:** A label near the 0930 posⁿ.

step ② :- In case of P.L, we draw course at any point

In case of P.C, we draw course at centre.

Step ③ : At point B, make $330^\circ \times 3 \text{ NM}$ i.e. BC

i.e. CMG & SMG

i.e. Transferred P.C @ 0930 hrs

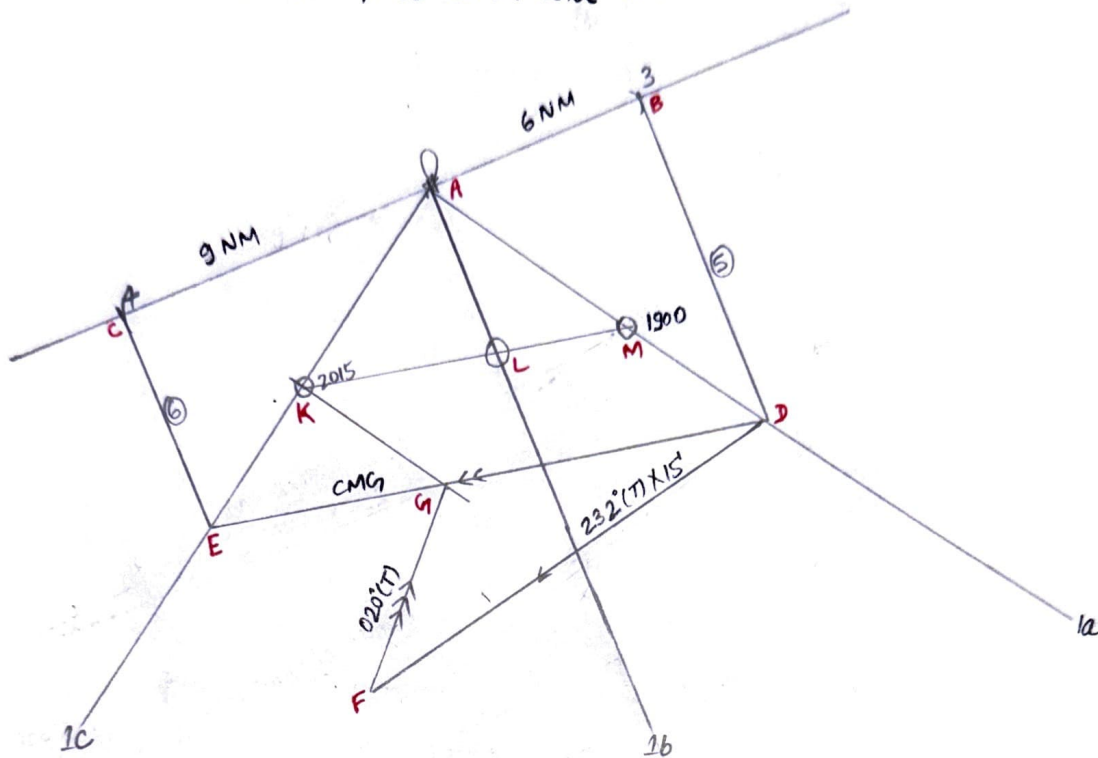
Step ⑦ : Shift CMG & SMG line where PL & PC cuts.

And, get a posⁿ.

0800 posⁿ:- $55^{\circ}13.5'N$, $015^{\circ}16.0'E$

THREE POINT BEARING

- (15) At 0800 hrs a vessel steering a course of $232^\circ(T)$ at 12 kts observes the following bearing of Utklippan Lt ($55^\circ 57'N$, $015^\circ 41'E$) at 1900 hrs: $282^\circ(T)$, 1930 hrs: $311^\circ(T)$, 2015: $023^\circ(T)$. If current is known to be setting $020^\circ(T)$. Find the position of vessel at 1900 and 2015 hrs. Also find CMG and SMG.



step ①: Draw three bearing (1a, 1b & 1c)

② : Draw a perpendicular to the middle bearing 16 at it house

③: Mark off the engine distance (3 & 4)

④ : Draw parallel to centre bearing at engine cut dist (5 & 6)

⑤ : Join DE i.e. CMG : $251^\circ = \text{Ans}$

DMG: 10.4 NM i.e for 01hr 15 min

SMG: 8.3 Kts = Ans

⑥ Draw DF i-e course steered with engine dist (15 nm)

⑦ Lay off current i.e. FG in direction $020^\circ(T)$

⑧ Transfer 1a to point G, where it cuts at 1c
i.e. posⁿ at 2015 hrs

2015 hrs POSITION: $55^{\circ} 52.2'N$ $015^{\circ} 38.5'E$ = Ans

⑨ Transfer DE to point K, where it cuts at 1(b)
i.e. posⁿ at 1930 hrs

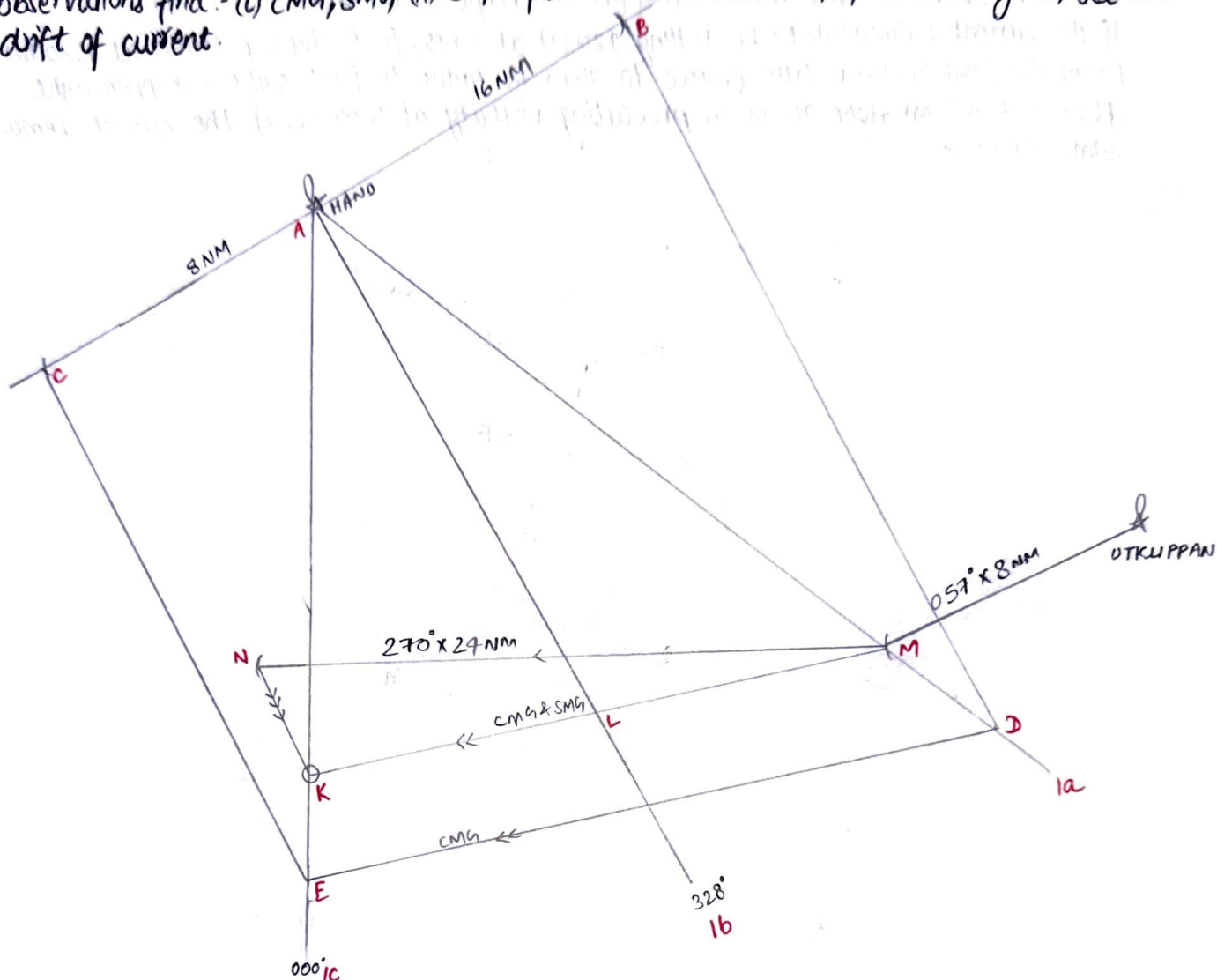
& where it cuts at 1a
i.e posⁿ at 1900 hrs

1900 hrs position: $55^{\circ} 55.2' N$ $015^{\circ} 56' E$ Ans

OCT 2024 AM, NOV 2022

- (19) A vessel steering 270° (T) observed Utklippan light ($55^\circ 57'N, 015^\circ 41'E$) bearing 057° (T) x 8' off. After running 16 miles by her engine, Engine speed 12 KTS on her course, Hano ($56^\circ 01'N, 014^\circ 51'E$) light bore 328° (T) and after running another 8' by engines it bore 000° (T). From the above observations find:- (i) CMG, SMG, (ii) Ship's position at the time of final bearing (iii) Set and drift of current.

Sol?



Step ①: Plot 057° (T) x 8 miles off at Utklippan
i.e. Initial posⁿ - (M)

Step ②: through (A), Draw 1a i.e. First bearing line from Hano

Step ③: Draw 2nd bearing line 328° i.e. 1b
& Draw 3rd bearing line 000° i.e. 1c

Step ④: Mark off the engine distance
Draw parallel to centre bearing
Join DE

① Step ⑤: Shift DE to initial posⁿ (M)
i.e. CMG & SMG

CMG: 255° (T) = Ans

DMG: 23.2 NM i.e. for 2 hrs

SMG: 11.6 KTS = Ans

②

③

Point K will be ship posⁿ at time of final bearing i.e.
Step ⑥: Plot co: 270° & engine dist: $8+16=24$ NM, joint it at K

Measure NK i.e. set & drift of current SET = 163° , CURRENT = 3 KTS = Ans

Step ① : On DR posⁿ 55°15'N, 016°00'E, plot 1800 & 1820 PL

② : On 1800 hrs PL, on any point

Draw course & current triangle for 20 min

③ Transfer 1800 hrs PL to Point C

Where this Transferred PL & 1820 hrs PL meet

i.e. 1820 posⁿ : 55°21'N 016°3.5'E Ans

④ Utklippan Lt Ho.

Nominal range = 24M

visibility = 5 miles

From luminous range diagram,

Luminous range = 14NM

$$\begin{aligned}\text{Geographical range} &= 2.095 \sqrt{h} + \sqrt{H} \\ &= 2.095(\sqrt{31} + \sqrt{15}) \\ &= 19.78 \text{ NM}\end{aligned}$$

Take whichever is less.

⑤ Draw P.C of 14 NM at Utklippan Lt house.

⑥ Since P.C is of 14 NM

And, engine speed is 12Kts, we have to make $14 \div 12 = 01 \text{ hrs } 10 \text{ min}$ triangle

Lay off current 120° x 5.83 NM i.e. for 01 hrs 10 min (EF)

⑦ Join D & F, i.e. CMG & SMG (DF)

⑧ Where the CMG cuts at P.C, mark it as G

⑨ Join E & G i.e. CTS (EG)

CTS: 330°(T) Ans

Now In same question,

if asks time of first sight at right ahead = ?

⑩ Measure GF i.e. 9.2 NM

Since it is 01 hrs 10 min triangle

So $SMG = 9.2 \div 01 \text{ H } 10 \text{ M}$

= 7.8 Kts

Now measure DG i.e. 25 NM

So, time taken = $25 \div 7.8$

= 03H 10M

So, 18H 20M

(+ 03H 10M)

21H 30M

Ans

If asks time of abeam = ?

⑪ Draw a line abeam

i.e. CTS + 90°

= 330° + 90°

= 060°

Extend line DF

where it meets i.e. Point H

i.e. Point when vessel abeam

Now measure GH i.e. 14.6 NM

So, time taken = $14.6 \div 7.8$

= 01H 52M

So, 21H 30M

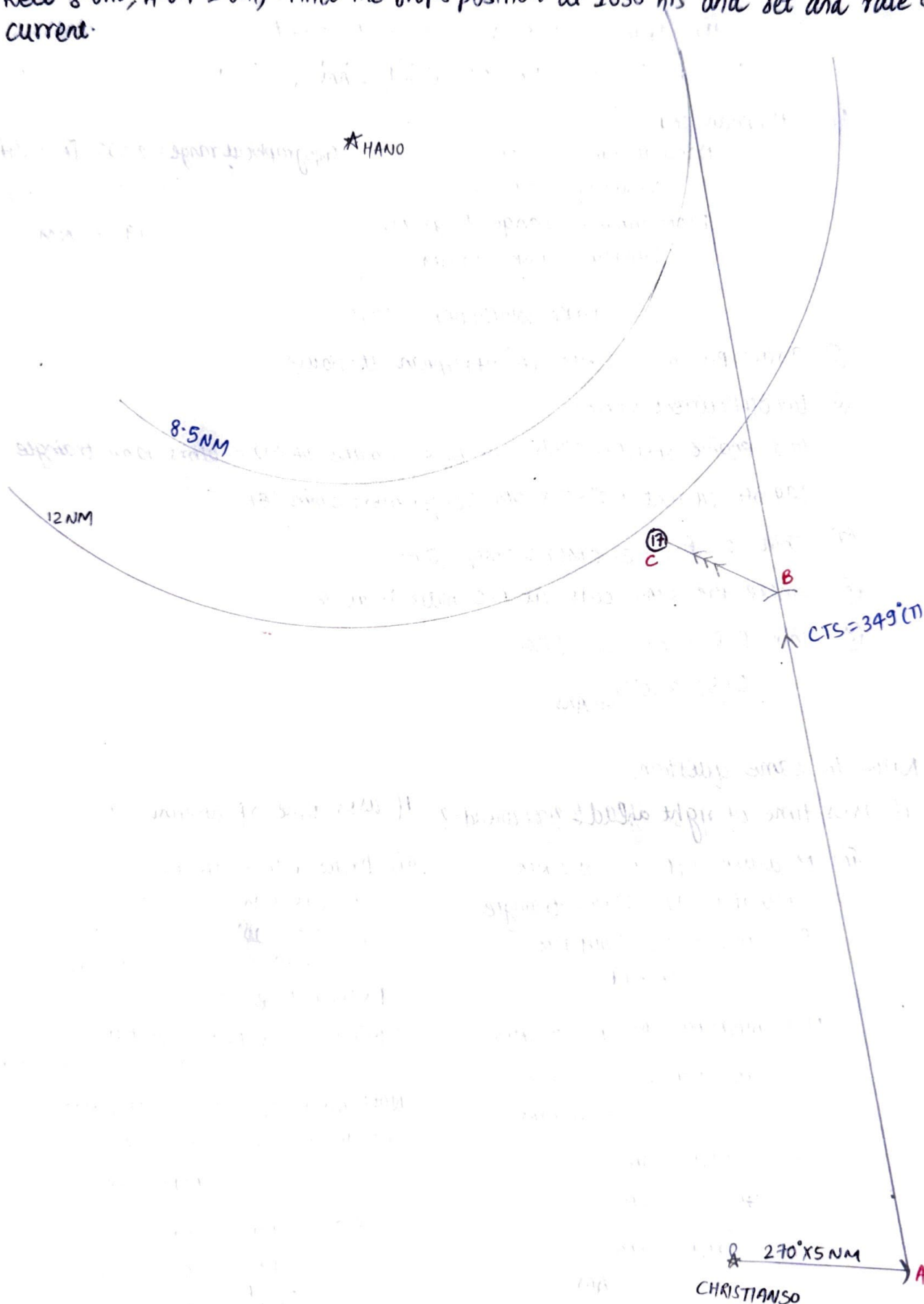
01H 52M

23H 22M

Ans

- (17) A vessel observes Christianso (S) Lt ($55^{\circ} 08' N, 015^{\circ} 09' E$) to bear $270^{\circ}(T)$ $\times 5$ nm at 0830 hrs. From this position, find course to steer to have Hano Lt ($56^{\circ} 01' N, 014^{\circ} 51' E$) 45° on Port Bow when it is 12 nm off. At 1030 hrs while on this course at a speed of 14 Kts the echo sounder recorded a sounding of 10m below keel (ship's draft even keel 8.0m, H.O.T 1.0m). Find the ship's position at 1030 hrs and set and rate of current.

Ans:-

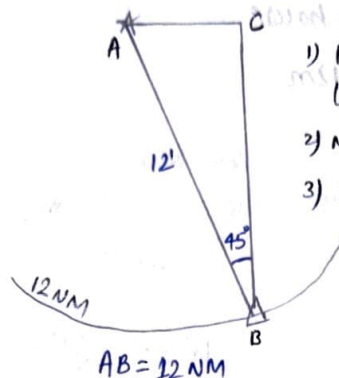


Step ①: Make 270° X 5 NM at Christiano Lt Ho.

i.e. 0830 HRS Posⁿ - (A)

②: Make 12 N.M P.C at HANO Lt Ho. (given in question)

③: Prepare a rough diagram



1) Put own ship on P.C anywhere in such a way that it looks approx 45° on Port side

2) Make a Δ

3) Find abeam distance.

$$\sin \theta = \frac{AC}{AB} \Rightarrow \sin 45^\circ = \frac{AC}{12}$$

$$\Rightarrow AC = 12 \times \sin 45^\circ = 8.5 \text{ NM}$$

i.e. abeam distance when vessel keep coming keeping HANO Lt Ho. 45° on Port Bow

④: Make a P.C of 8.5 NM

⑤: Make a target from 0830 Posⁿ to 8.5 NM P.C

i.e. CTS = 349° (T) = Ans

To find posⁿ of 1030 hrs :-

⑥ 0830 to 1030 hrs = 02 HRS

Speed = 14 Kts

Engine distance = 28 NM

Mark 28 NM cut on CTS - (B)

⑦ Ship's draft = 8.0 m

Sounding B.K. = 10.0 m

Water depth = 18.0 m

H.O.T = 1.0 m

Charted depth = 17.0 m

Find 17 NM patch on chart & join from 28 NM cut (BC)

⑧ Measure BC i.e. set and rate of current

Set: 295° X 1.3 Kts = Ans

⑨ Ship's position at 1030 hrs i.e. at Point C

Lat: 55° 47.5' N

Long: 015° 6.5' E

= Ans

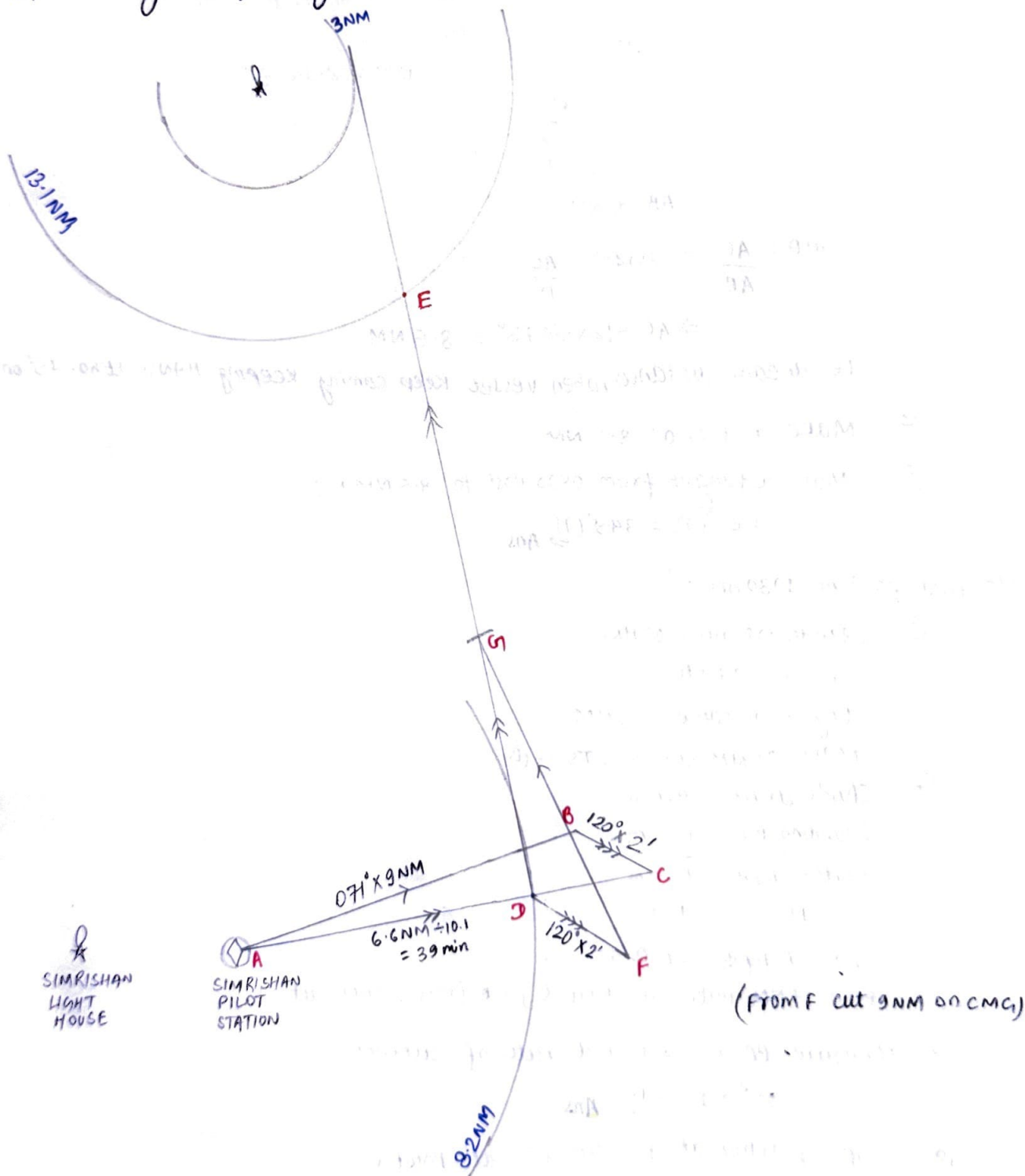
⑤

OCT 2023

At 2000 hrs, a vessel drops pilot at Simrishamn Pilot station ($55^{\circ} 33.5'N$, $014^{\circ} 24'E$) and steers a course of $071^{\circ}(T)$ at 9 kts with Meteorological visibility being 5 NM. Master decides to alter course when Simrishamn Lt (ISO WRG 6s) is last seen. After altering course she is to pass HANO Lt ($56^{\circ} 01'N$, $014^{\circ} 51'E$) 3 nm on her port side. If current was setting $120^{\circ}(T)$ at 2 kts, find the time and posⁿ when

- vessel alters course towards HANO Lt house
- HANO light is first sighted H.E: 12m

Soln:-



Step ① :- From Simrishan Pilot Stn make 01hrs A

② :- Check when Simrishan Lt Ho will be last seen

Nominal range: 13 NM (bcz vessel is in white sector)

visibility : 5 NM

From luminous range diagram,

luminous range = 8.2 NM

$$\text{Geographical range} = 2.095 \sqrt{h} + \sqrt{H}$$

$$= 2.095 (\sqrt{13} + \sqrt{12})$$

$$= 14.8 \text{ NM}$$

Take whichever is less

③ Make a P.C of 8.2 NM from SIMRISHAN Lt Ho.

where it cuts at CMG i.e. point when vessel will alter course towards HANO (D)

Posn Lat: $55^{\circ} 34.8' \text{N}$

Long: $014^{\circ} 35.8' \text{E} = \text{Ans}$

④

Measure AC i.e. SMG = 10.1 Kts.

Now to calculate time

Measure AD i.e. $6.6 \text{ NM} \div 10.1 \text{ Kts}$
 $= 39 \text{ min}$

Drops pilot at: 20H 00M

AD : $\frac{39 \text{ M}}{}$

Time when co. alter: 20H 39M

2039 HRS = Ans

⑤ Since, question says, after altering course vessel to pass HANO Lt Ho. 3 NM on her port side.

Make 3N.M P.C.

Draw a tangent to that P.C from point D i.e. CMG

⑥ To find posn when HANO light first sighted

Nominal range: 24 NM

visibility : 5 NM

Luminous range: 13.1 NM
(from luminous range diagram)

$$\text{Geographical range} = 2.095 \sqrt{h} + \sqrt{H}$$

$$= 2.095 (\sqrt{70} + \sqrt{12})$$

$$= 24.8 \text{ NM}$$

Take whichever is less.

Make a P.C of 13.1 NM at HANO Lt house

Where it cuts at CMG i.e. point when HANO light first sighted - (E)

Posn Lat: $55^{\circ} 47.3' \text{N}$

Long: $014^{\circ} 46.5' \text{E} = \text{Ans}$

⑦ To find time when HANO light first sighted

→ First find new SMG (bcz SMG change due to alteration of course)

Measure Da i.e. SMG = 8.8 Kts

→ Now measure DE i.e. $15 \text{ NM} \div 8.8 \text{ Kts}$
 $= 01H 42M$

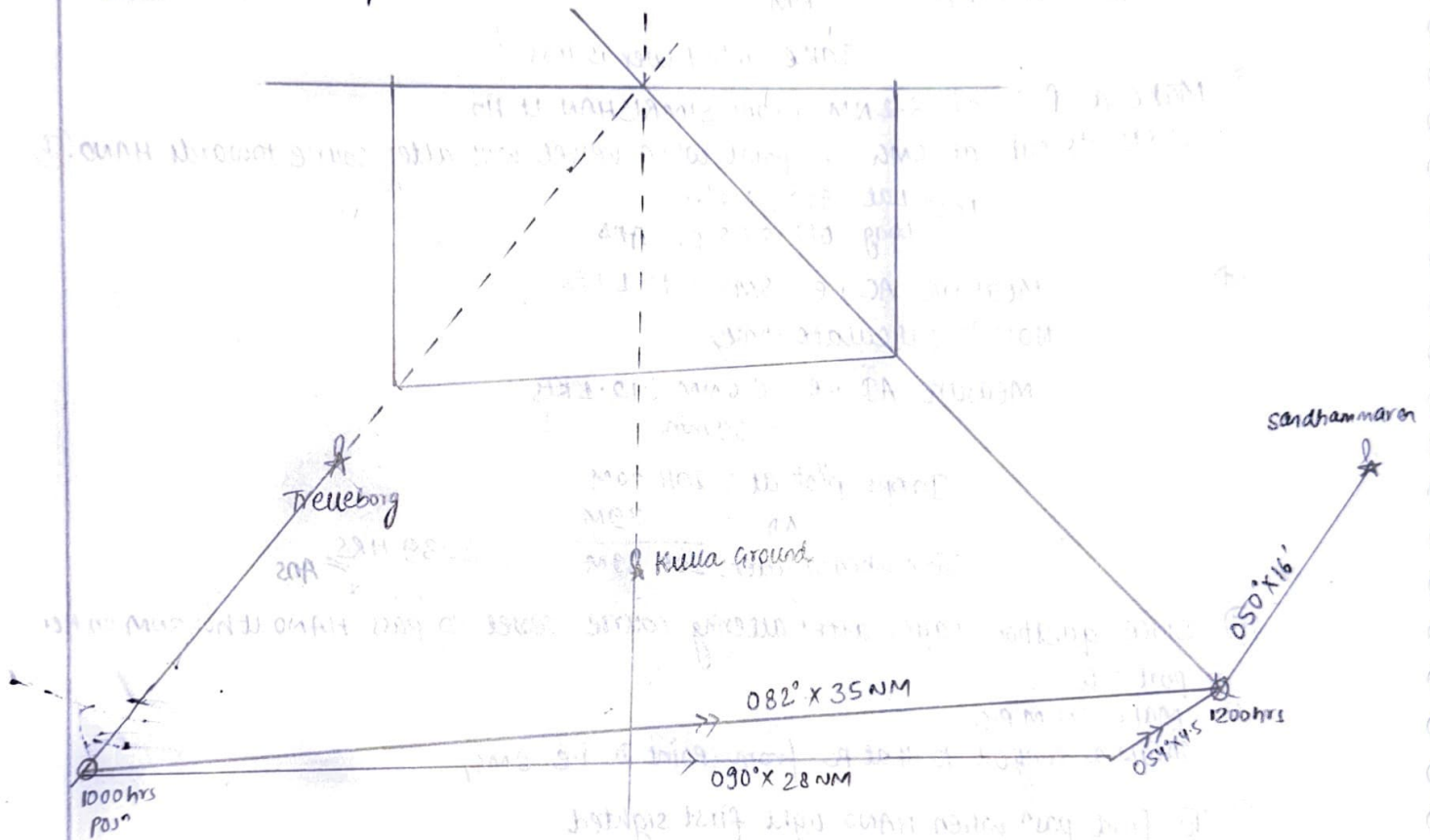
(D) : 20H 39M

DE : 01H 42M

(E) : 22H 21M

2221 HRS = Ans

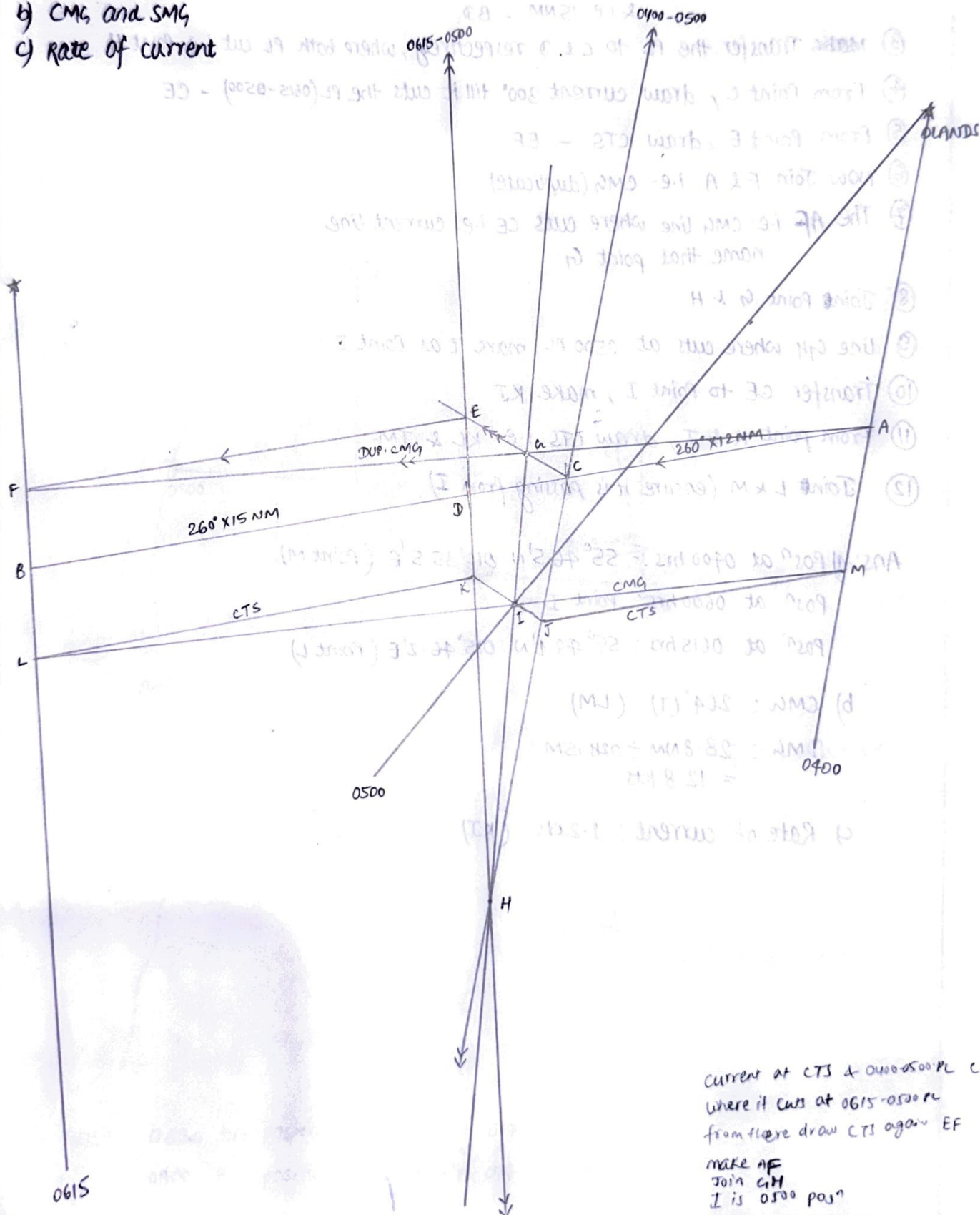
- ⑦ At 1000 hrs Treueborg Racon Lt to bore $040^\circ(T)$, at 1100 hrs Kulla Grund Lt to bore $000^\circ(T)$ and at 1200 hrs Sandhammarren Lt house bore $050^\circ(T) \times 16 \text{ NM}$ off vessel was steering a course of $090^\circ(T)$ at 14 kts. Find the following:-
- Position of the vessel at 1000 hrs and 1100 hrs
 - CMG, SMG
 - Set and Rate of current:



FISH TRAINGLE

(14) A vessel steering a course of $260^{\circ}(T)$ at 12 kt observed Olandi Soda Grund Lt ($56^{\circ}04.3'N$, $016^{\circ}41.2'E$) bearing 010° at 0400 hrs. Again at 0500 hrs, the same light bore $040^{\circ}(T)$. At 0615 hrs, Utklippan Lt ($55^{\circ}57'N$, $015^{\circ}42'E$) bore $351^{\circ}(T)$. If the current was setting $300^{\circ}(T)$, Find the following:

- Position of the ship at 0400 hrs and 0615 hrs
- CMG and SMG
- Rate of current



Current at CTS & 0400-0500 PL CE
where it cuts at 0615-0500 PL
from there draw CTS again EF
make AF
Join GH
I is 0500 posn
From T & K make CTS i.e. KL & JM
Join LM

Step ①: Draw all 03 bearing i.e. at Olundi Soda Ground :- 0400 : 010°(T)

0500 : 040°(T)

at UTKUPPAN Lt Ho : 0615 : 351°(T)

- ② Take a random point & draw a CTS i.e. AB
Cut off engine distance i.e. 12 NM - AC
& i.e. 15 NM - BD
- ③ ~~Make~~ Transfer the PL to C & D respectively, where both PL cut i.e. Point H
- ④ From Point C, draw current 300° till it cuts the PL(0615-0500) - CE
- ⑤ From Point E, draw CTS - EF
- ⑥ Now Join F & A i.e. CMG (duplicate)
- ⑦ The AF i.e. CMG line where cuts CE i.e. current line
name that point G
- ⑧ Join Point G & H
- ⑨ Line GH where cuts at 0500 PL, mark it as Point I
- ⑩ Transfer CE to Point I, make KJ
- ⑪ From point K & J, draw CTS i.e. KL & JM
- ⑫ Join L & M (ensure it is passing from I)

Ans:- a) Posⁿ at 0400 hrs :- 55° 46.5' N 016° 35.5' E (Point M)

Posⁿ at 0600 hrs: Point I

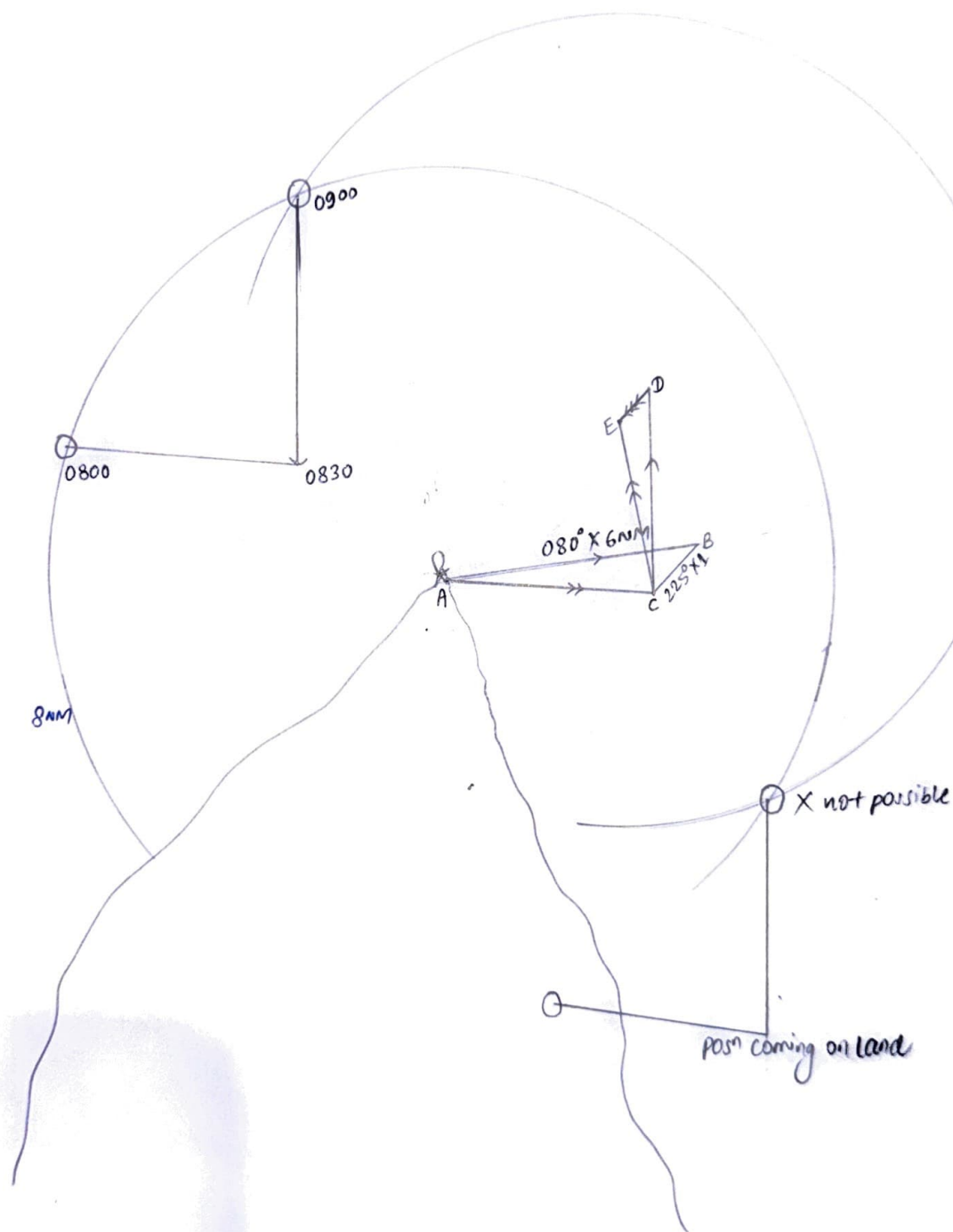
Posⁿ at 0615 hrs: 55° 43.1' N 015° 46.2' E (Point L)

b) CMG : 264°(T) (LM)

DMG : $28.8 \text{ NM} \div 02 \text{ H } 15 \text{ M}$
= 12.8 Kts

c) Rate of current : 1.2 Kts (KJ)

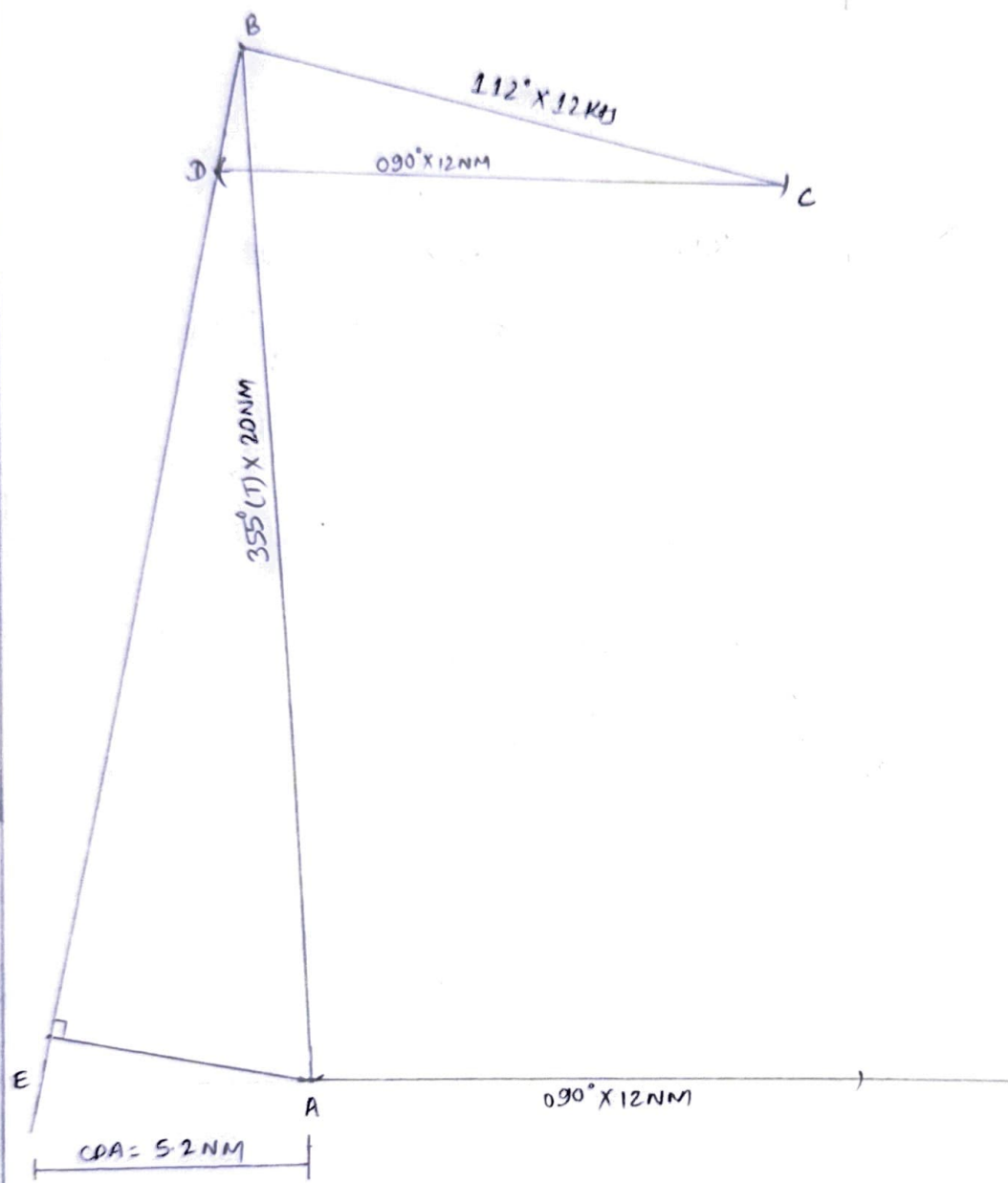
- ⑥ At 0800 hrs Hammerodde Lt Ho ($55^{\circ}18'N$, $014^{\circ}47'E$) was observed 8 nm off by radar. vessel was steering a course of $080^{\circ}(T)$ at 12 kts. At 0830 hrs, she altered CO to $000^{\circ}(T)$ to avoid an immediate danger. At 0900 hrs Hammerodde Lt Ho was observed again 8 nm off by RADAR. if current was setting SW at 2 kts. Find the position of vessel at 0830 and 0900 hrs.



Ans:- 0830 hrs position: $55^{\circ}19.5'N$ $014^{\circ}41.5'E$
 0900 hrs position: $55^{\circ}24.8'N$ $014^{\circ}40.2'E$

20

At 1800 hrs a Tanker is $355^\circ(T) \times 20\text{nm}$ of a cargo vessel and is steering $112^\circ(T)$ at 12 kts. The cargo vessel is steering a course $090^\circ(T)$ at 12 kts. Find the minimum distance they will pass and find the time they will be closest to each other.



$$BE = 20.5 \text{ NM}$$

$$BD = 4.8 \text{ NM}$$

From B to D = 4.8 NM in 1 hrs

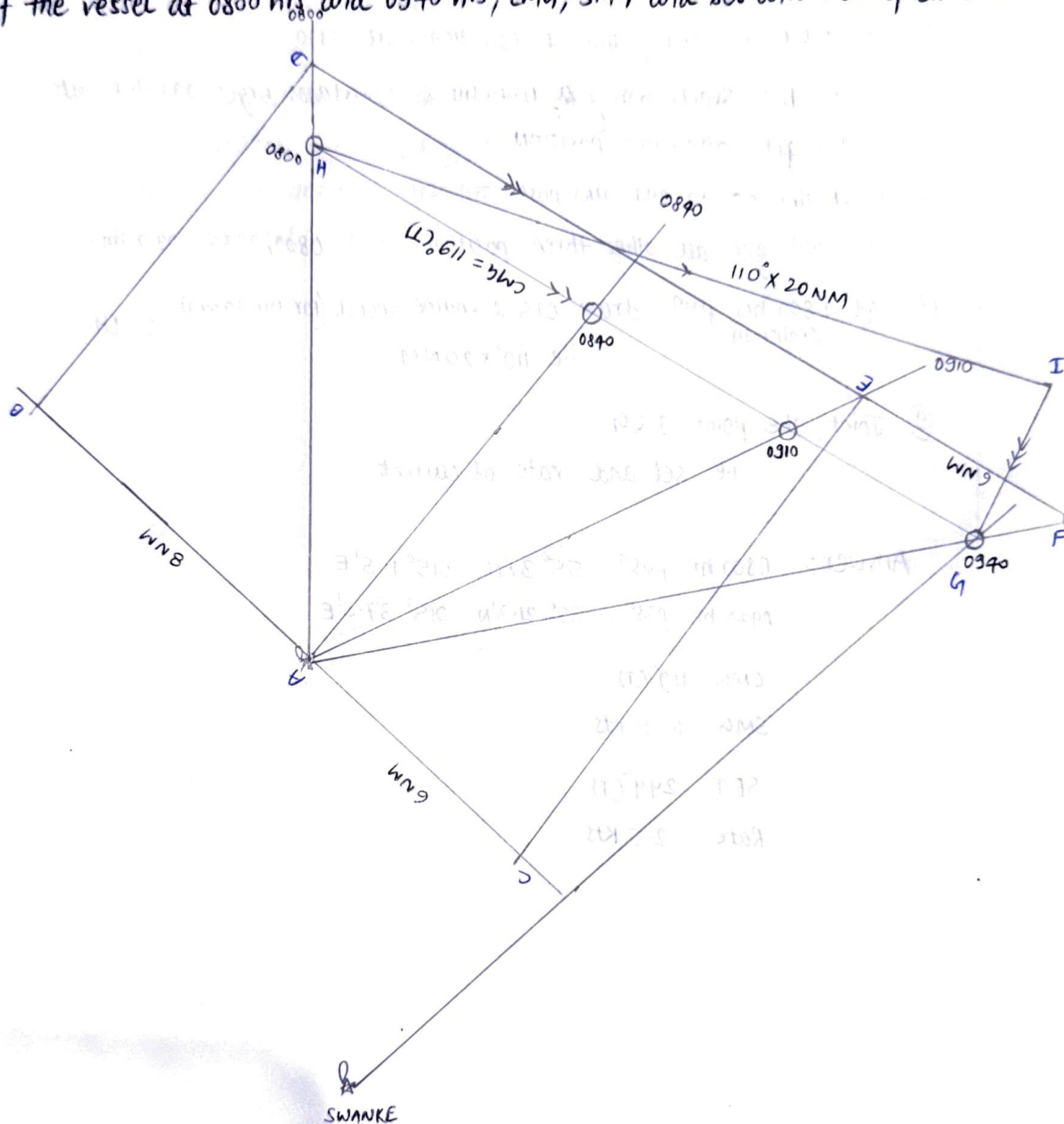
$$\text{So, } BE = \frac{20.5}{4.8} = 4\text{H } 16\text{M}$$

From 1800 hrs

$$+ 04\text{H } 16\text{M}$$

$$\text{TCPA} = 22\text{H } 16\text{M}$$

- (25) While steering a course $110^\circ(T)$ at 12 Kts, the following bearings of Christianso (S) Lt ($55^\circ 08'N$, $015^\circ 09'E$) were observed from a vessel, ~~at 0800 hrs~~ $180^\circ(T)$ at 0800 hrs, $220^\circ(T)$ at 0840 hrs, 245° at 0910 hrs. At 0940 hrs, Swanke Lt H.O. ($55^\circ 08'N$, $015^\circ 09'E$) bore $230^\circ(T)$. Find posⁿ of the vessel at 0800 hrs and 0940 hrs, CMG, SMG and set and rate of current.



Step ①: Christianso (S) Lt H.O.

0800 HRS : $180^\circ(T)$

0840 HRS : $220^\circ(T)$

0910 HRS : $245^\circ(T)$

Plot all four bearing.

② Draw perpendicular to middle bearing.

cut engine distance i.e. 6 NM & 8 NM i.e. B & C

Draw parallel to middle bearing at engine distance. & it cuts at D & E

Swanke Lt H.O.

0940 HRS : $230^\circ(T)$

- ③ Join D & E i.e. fake CMG
- ④ Extend line DE & from E cut 6 NM (i.e. engine distance from 0910-0940)
we get F
- ⑤ Join A & F i.e. bearing line of Christiano at 0940.
- ⑥ Where the Swanke bearing @ 0940 hrs & Christiano brg @ 0940 hrs cuts
We get, 0940 HRS POSITION
- ⑦ Shift line FD to 0940 HRS POS^N
we will get all other three position i.e. of 0800, 0840 & 0910 hrs
- ⑧ At 0800 hrs posⁿ, draw CTS & engine speed (for 1 hr 40 min) ; IH
(point H)
i.e. $110^\circ \times 20 \text{ NM}$
- ⑨ Joint the point I & G
i.e. set and rate of current

Answer:- 0800 hrs posⁿ: $55^\circ 30' \text{N}$ $015^\circ 11.5' \text{E}$

0940 hrs posⁿ: $55^\circ 21.3' \text{N}$ $015^\circ 37.5' \text{E}$

CMG: 119°CT

SMG: 10.5 KTS

SET: 244°CT

Rate: 2.5 KTS.

- (13) At 2100 hrs, a vessel in position 3 miles North of Horse shoe Rocks buoy ($51^{\circ} 15' N$, $004^{\circ} 13.5' W$) experiencing a current setting NW^{1/2} steams as follows:-

2100 - 2120 course steering unknown

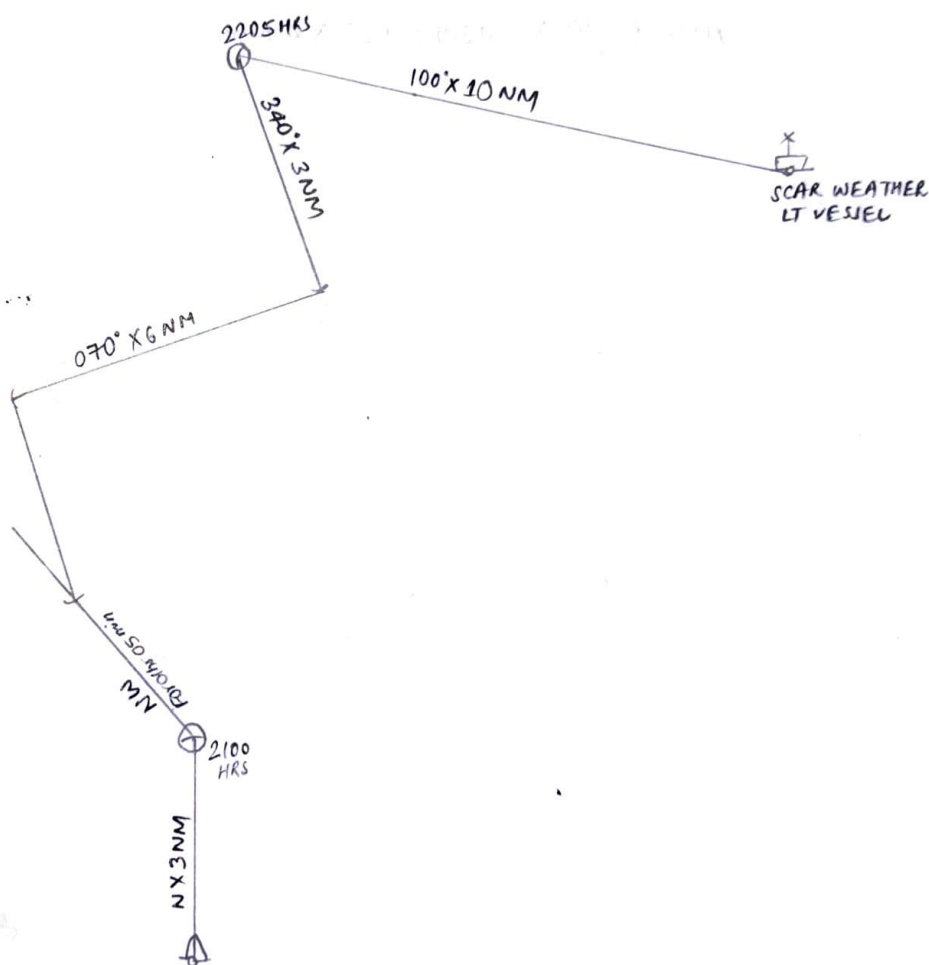
2120 - 2150 course steering $070^{\circ}(T)$

2150 - 2205 course steered $340^{\circ}(T)$

At the end of this steaming, she observes SCAR weather Lt VSL ($51^{\circ} 27' N$, $003^{\circ} 57' W$) bearing $100^{\circ}(T)$ distance 10 miles, Engine speed - 12 kts, find

a) Course steering from 2100 hrs to 2120 hrs

b) Rate & drift of current



2100 - 2120 : $00^{\circ} \times 4 \text{ NM}$

2120 - 2150 : $070^{\circ} \times 6 \text{ NM}$

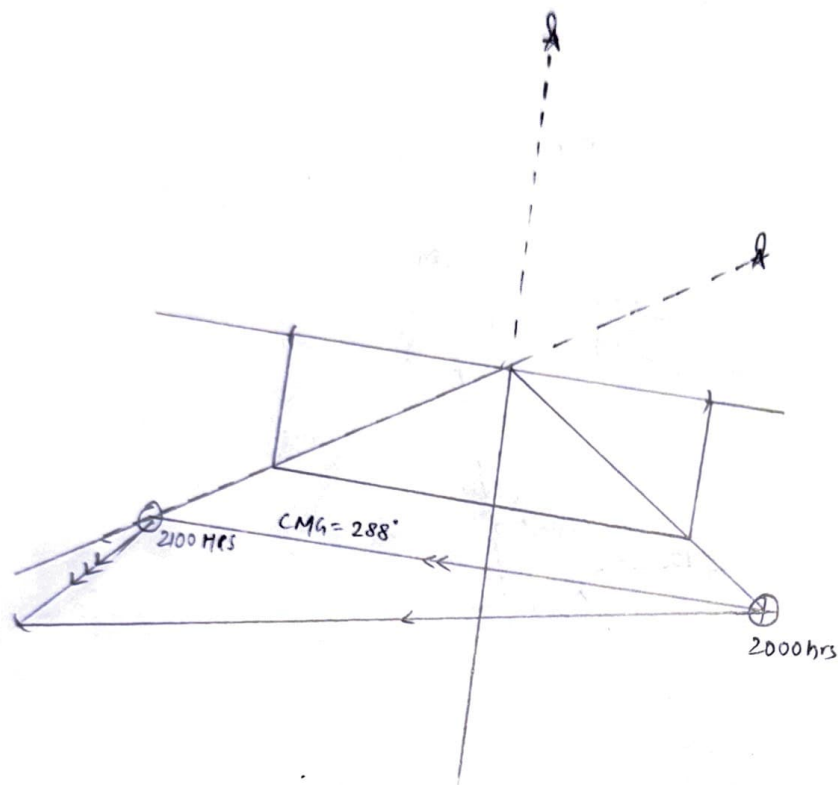
2150 - 2205 : $340^{\circ} \times 3 \text{ NM}$

Ans:- a) $330^{\circ}(T)$

b) 2.9 Kts

17

A vessel was stopped and anchored in an emergency in position $51^{\circ}05'N$, $004^{\circ}35'W$. At 2000 hrs she sailed from this position on a course $273^{\circ}(G)$ at 12 Kts. At 2030 hrs, North Lundy Island light was observed for the first time and at 2100 hrs South Lundy Island light was just obscured. If gyro error was $2^{\circ}(LOW)$, find:
 a) vessel's position at 2100 hrs b) set and rate of current c) CMG



Ans:- a) Posⁿ at 2100 Hrs: $51^{\circ}07.8'N$ $004^{\circ}49'W$
 b) Set: $060^{\circ}(T)$ Rate: 3.7 Kts
 c) CMG: 288°

White steering 100°(T) at 1400 hrs, a vessel at 1416 observed bull point Lt house ($51^{\circ}12'N, 004^{\circ}12'W$) 30° on stbd bow. This angle has doubled in 27 minutes. At 1510 hrs, this light house was abeam. Current is known to set $330^{\circ}(T)$. Find the time, bearing and distance from scar weather Lt vessel ($51^{\circ}26.8'N, 003^{\circ}56.2'W$) when the bull point light house would dip if HE is 6m.

A hand-drawn navigation diagram on a grid background. The diagram shows a ship's track starting from a point at the bottom left, moving towards the top right. Key elements include:

- Ship's Track:** A line starting from a point labeled "Just for reference co: 100° 0' 0''". The track is marked with "5 NM" at two points.
- Target Point:** A point labeled "1510 post" is marked with a circled cross. It is located at a bearing of $100^\circ \times 12.6'$ from the starting point.
- Other Bearings and Distances:**
 - A bearing of 1416 is marked from the starting point.
 - A bearing of 1443 is marked from the starting point.
 - A bearing of 1416 is marked from the "1510 post" point.
 - A bearing of 1510 is marked from the "1510 post" point.
 - A bearing of 330° is marked from the "1510 post" point.
 - A bearing of 12.9 AM is marked from the "1510 post" point, with a note "i.e. 1 hrs 11 min".
 - A bearing of 19.5 is marked from the "1510 post" point, with a note "from bull point".
 - A bearing of $285^\circ \times 9'$ is marked from the "1510 post" point.
 - A bearing of $9.8 \text{ NM for } 54 \text{ min}$ is marked from the "1510 post" point.
 - A bearing of 5 NM is marked from the "1510 post" point.
 - A bearing of 5 NM is marked from the starting point.
 - A bearing of 30° is marked from the starting point.
 - A bearing of $100^\circ 07'$ is marked from the starting point.

DMG: 9.8 NM for 54 min, so, SMG = 10.9 Kts.

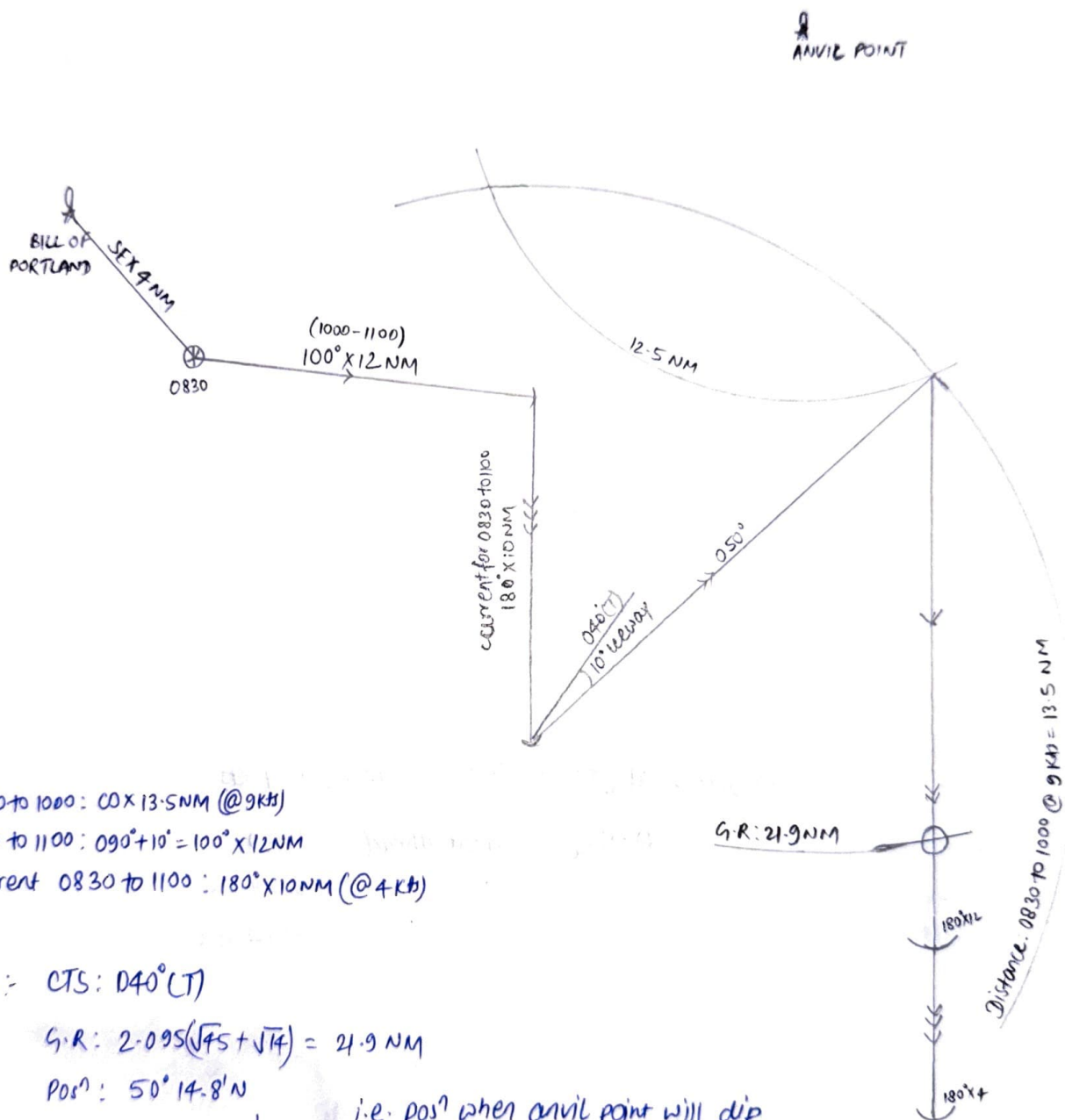
c) from 1510 to dipping point: 12.9 NM i.e. 1 hrs 11 min

$$\begin{array}{r} 15h \ 10m \\ 1h \ 11m \\ \hline 16h \ 21m \end{array}$$

5056

- (26) A vessel was located 4 miles SE of Bill of Portland Lt Ho ($50^{\circ} 31' N$, $002^{\circ} 27' W$) at 0830 hrs and steering a certain course at 9 Kts. At 1000 hrs she increased her speed to 12 Kts and alter her course to $090^{\circ}(T)$. One hour later Anvil Point Lt Ho ($50^{\circ} 35' 4'' N$, $001^{\circ} 57' 6'' W$) was 12.5' away by radar, same time she altered her course to $180^{\circ}(T)$. Find the true course steered between 0830 hrs and 1000 hrs and time and position when Anvil Pt Lt Ho would dip, wind N^W, leeway 10', HE 14m and current was setting throughout $180^{\circ}(T)$ at 4 Kts.

Soln:-

0830 to 1000: $CO \times 13.5 NM$ (@ 9 Kts)1000 to 1100: $090^{\circ} + 10^{\circ} = 100^{\circ} \times 12 NM$ current 0830 to 1100: $180^{\circ} \times 10 NM$ (@ 4 Kts)Ans: CTS: $040^{\circ}(T)$ G.R: $2.095(\sqrt{75} + \sqrt{14}) = 21.9 NM$ Pos: $50^{\circ} 14.8' N$ $001^{\circ} 48.5' W$

= Ans

i.e. posⁿ when anvil point will dipSMG = $12 + 4 = 16 Kts$

dipping distance = 9 NM i.e. 33.5 MIN

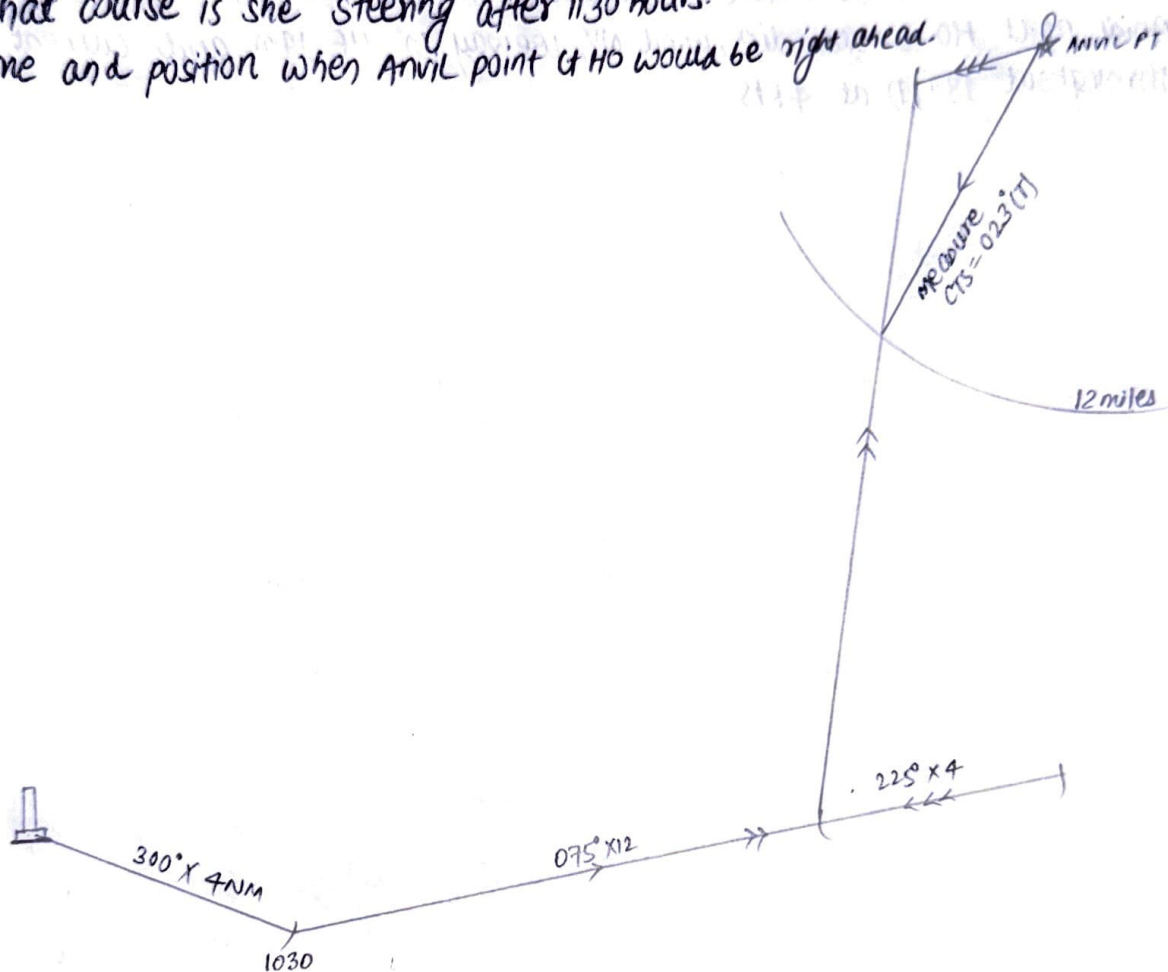
1100
+ 33.51133 HRS i.e. time when Anvil point would dip.

28

MARCH 2022

At 1030 hrs, while steering $075^\circ(T)$ at 12 kts through current setting $255^\circ(T)$ at 4 kts, a vessel leaves 'E channel Racon' four points on her port quarter at 4 miles. At 1130 hrs she increased her speed to 16 kts and sets course to Anvil point Lt Ho right ahead when 12 miles away. Find

- What course is she steering after 1130 hours.
- Time and position when Anvil point Lt Ho would be right ahead.

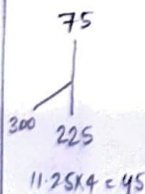


Answer:- a) CTS: $023^\circ(T)$, SMG = 13.7 kts

b) Time of right ahead = 1130

+ 0154

1324 hrs



- ④ At 1900 hrs your vessel is 5 NM south of Tushkar rocks and has to be rendezvous with another vessel to pickup cargo hoses. Vessel has just dropped pilot at Cork Harbour Pilot station and steering a course of $130^\circ(\text{TT})$ at 10 kts. The current in the area is expected to set SW by at 1.5 kts throughout. Determine the following:-
- Course to steer and Engine speed required to rendezvous at day break i.e. at 0600 hrs.
 - The Rendezvous position.

Soln:-

PLOTING AT NEXT PAGE

1900: $180^\circ \times 5 \text{ NM}$ @ Tushkar Rocks, VSL 'A': $52^\circ 07.2' \text{N}$ $006^\circ 12.4' \text{W}$ At Cork harbour pilot station, $130^\circ \times 10 \text{ kts}$, VSL 'B': $51^\circ 45' \text{N}$ $008^\circ 15.4' \text{W}$ current: SW by $\times 1.5 \text{ kts}$ We get, CMG: 139° S 41 E SMG: 10 kts

1900 to 0600 = 11 hrs

Apply run for 11 hours

From posⁿ of vessel 'B'Lat B: $51^\circ 45' \text{N}$

$$\cos \text{CO} = \frac{d' \text{lat}}{\text{dist}}$$

d'lat: $1^\circ 23' \text{S}$

$$(\cos 139^\circ \times 110)$$

VSL B Final lat: $50^\circ 22' \text{N}$ m'lat = $51^\circ 3.5'$

$$\cos m' \text{lat} = \frac{\text{dep}}{d' \text{long}}$$

$$\cos 51^\circ 3.5' = \frac{72.2'}{d' \text{long}}$$

$$d' \text{long} = 1^\circ 54.9' \text{E}$$

Long B: $008^\circ 15.4' \text{W}$

$$\sin \text{CO} = \frac{\text{dep}}{\text{dist}}$$

d'long: $1^\circ 54.9' \text{E}$ VSL B Final long: $06^\circ 20.5' \text{W}$

$$\sin \text{CO} = \frac{\text{dep}}{\text{dist}}$$

$$\sin 139^\circ = \frac{\text{dep}}{110}$$

$$\text{dep} = 72.2' \text{E}$$

VSL B Final Posⁿ: $50^\circ 22' \text{N}$ $06^\circ 20.5' \text{W}$ Initial Lat A: $52^\circ 07.2' \text{N}$ Final Lat B: $50^\circ 22' \text{N}$ d'lat: $1^\circ 45.2' \text{N}$ m'lat: $51^\circ 14.6' \text{N}$

$$\text{Dist}^2 = \text{Dep}^2 + d' \text{lat}^2$$

$$\text{Dist}^2 = (5.07)^2 + (1.45.2')^2$$

$$\text{Dist} = 105.32 \text{ NM} \div 11 = 9.6 \text{ kts}$$

$$\cos \text{CO} = \frac{d' \text{lat}}{\text{dist}}$$

$$\cos \text{CO} = \frac{1^\circ 45.2'}{105.32}$$

$$\text{CO} = 52.74 \text{ W} = 182.74 \text{ i.e. CMG}$$

Initial Long A: $006^\circ 12.4' \text{W}$ Final Long B: $006^\circ 20.5' \text{W}$ d'long: $8.1' \text{W}$

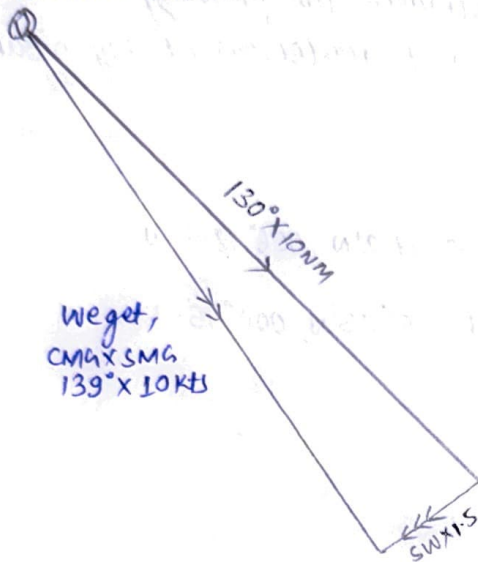
$$\cos m' \text{lat} = \frac{\text{dep}}{d' \text{long}}$$

$$\cos 51^\circ 14.6' = \frac{\text{dep}}{8.1'}$$

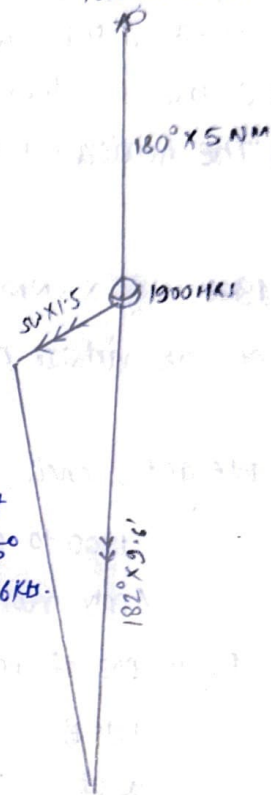
$$\text{dep} = 5.07' \text{W}$$

$$\text{SMG} = 9.6 \text{ kts}$$

CORK HARBOUR P.S.M



TUSHKAR ROCKS



ANS:- CTS: 175° (T)

SPD: 8.6 Kts

DMG: 105.32 NM

POSⁿ: OUT OF THE CHART

Blind navigation

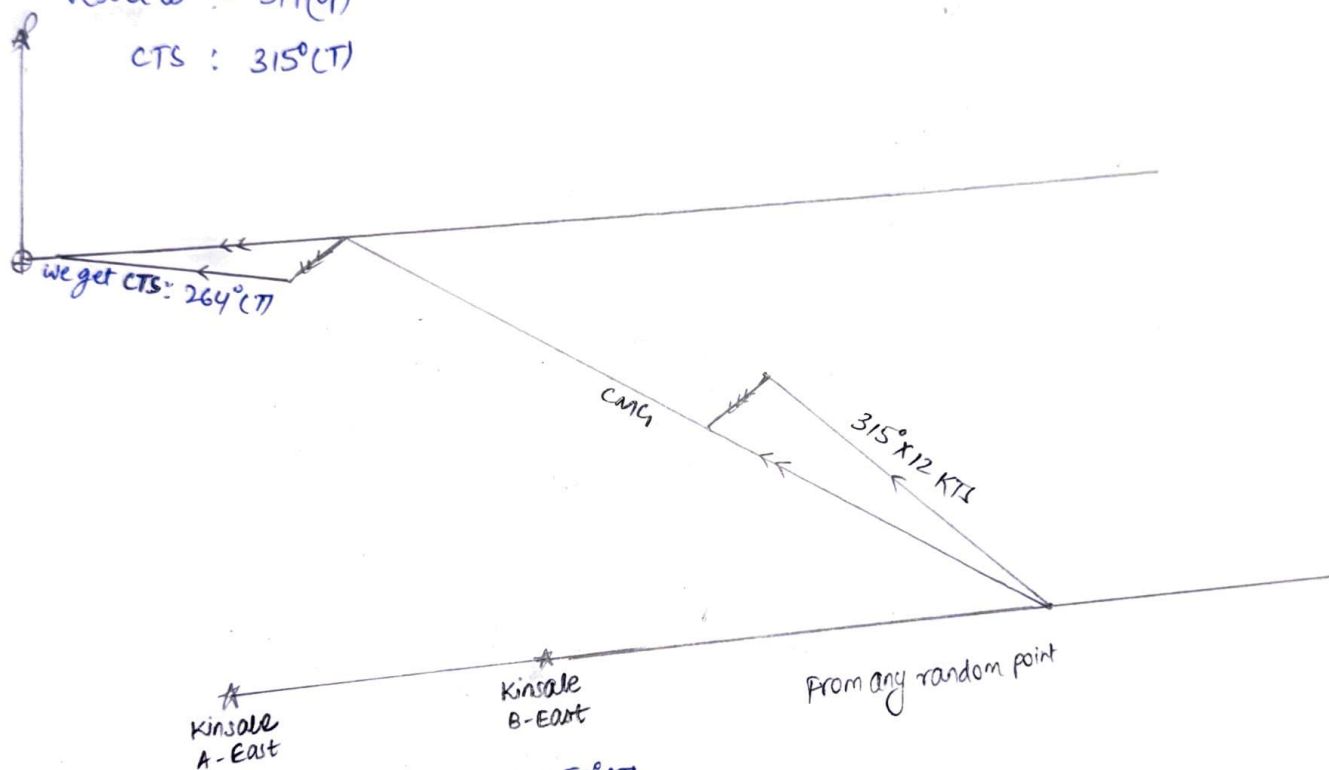
- ③ A vessel navigating near East of Kinsale. Allfields observes the following:
 At 2400 hours Kinsale A - East platform ($51^{\circ} 22' N$, $007^{\circ} 57' W$) and Kinsale B - West platform ($51^{\circ} 21' 5'' N$, $008^{\circ} 01' W$) in transit on a bearing $260^{\circ}(G)$. Later the visibility reduces to zero. The ship is steering a course $317^{\circ}(G)$. Current is setting SW at 2 kts E. Spd - 12 kts. Find :- (i) Gyro error (ii) Safe course by gyro to alter as to safely pass 3nm south of Old Head Kinsale light (iii) Time of alteration.

Soln:

Transit brg :- $260^{\circ}(G)$, True brg : $258^{\circ}(T)$, so gyro error = $2^{\circ} H$

vessel co :- $317^{\circ}(G)$

CTS : $315^{\circ}(T)$



Step ① : Extend transit bearing $258^{\circ}(T)$

② : From any random point plot, $CTS \times E \cdot spd = 315^{\circ} \times 12 kts$
 & current = SW $\times 2 kts$

We get CMG

- ③ Draw/transfer parallel of transit brg to posⁿ 3nm south of Old Head Kinsale at home.
 ④ Extend CMG to that line

JULY
2023
PAPER 2

A vessel steering course $005^\circ(T)$ at 12 knots observes bearing of Due dde light to be $224^\circ(C)$ and Svancke light as $290^\circ(C)$ at 2200 hrs. The current in the area was setting $082^\circ(T)$ at 3 knots. After sailing for 35 minutes the compass bearing of Svancke and Chritiano North light were $226^\circ(C)$ and $324^\circ(C)$ respectively. Find CMG, SMG, position at 2200 hrs and 2235 hours.

Soln:-

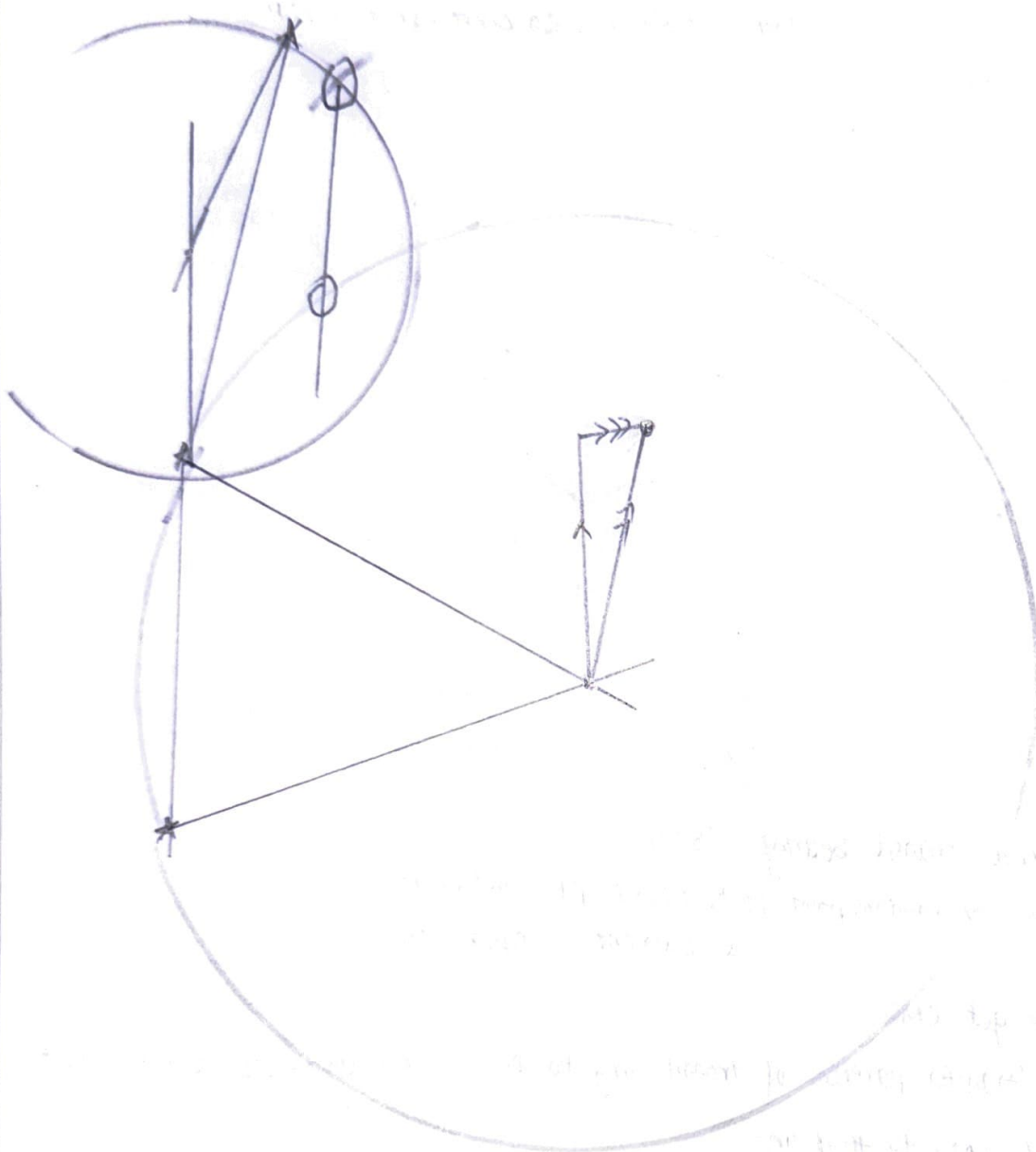


CHART 5048

(10)
MAY
2022

At 0812 hrs HOOK head Lt H0. ($52^{\circ} 07.4'N$, $006^{\circ} 55.8'W$), bore $292^{\circ}(C)$ and Conibeg Lt VSL ($52^{\circ} 02.4'N$, $006^{\circ} 39.4'W$) bore $170^{\circ}(C)$, vessel then steered a course of $182^{\circ}(T)$ at 9 Kts in SE'ly wind with current setting $250^{\circ}(T)$ at 3 Kts, L'way is 8° . Later maintaining same CO2 speed HOOK head Lt house dipped at 1014 hours. Find compass errors and position of the vessel at both times HE-12m

Soln:-

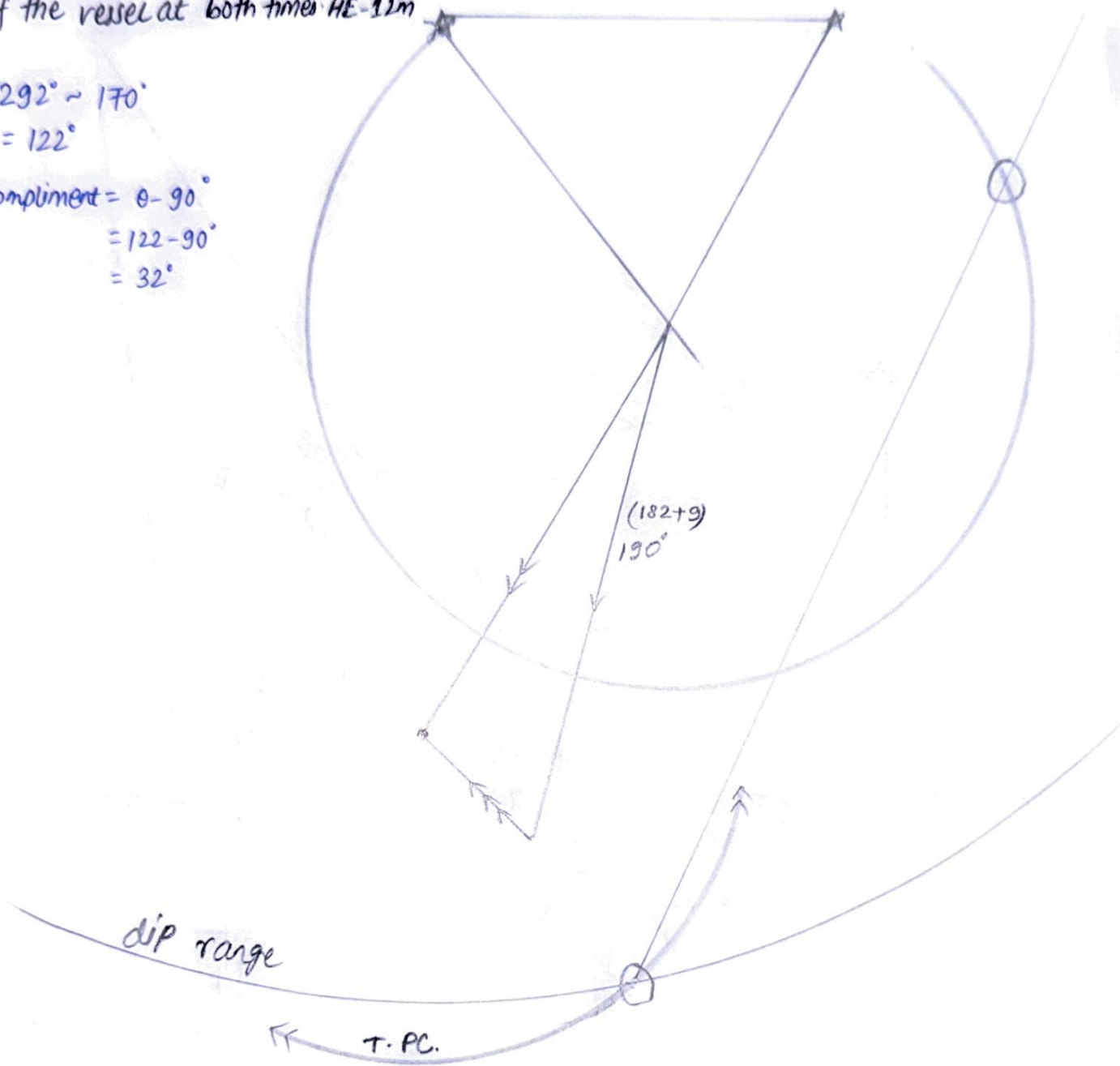
292° ~ 170°

$$= 122^\circ$$

Compliment = $90^\circ - \theta$

$$= 122 - 90^\circ$$

$$= 32^\circ$$

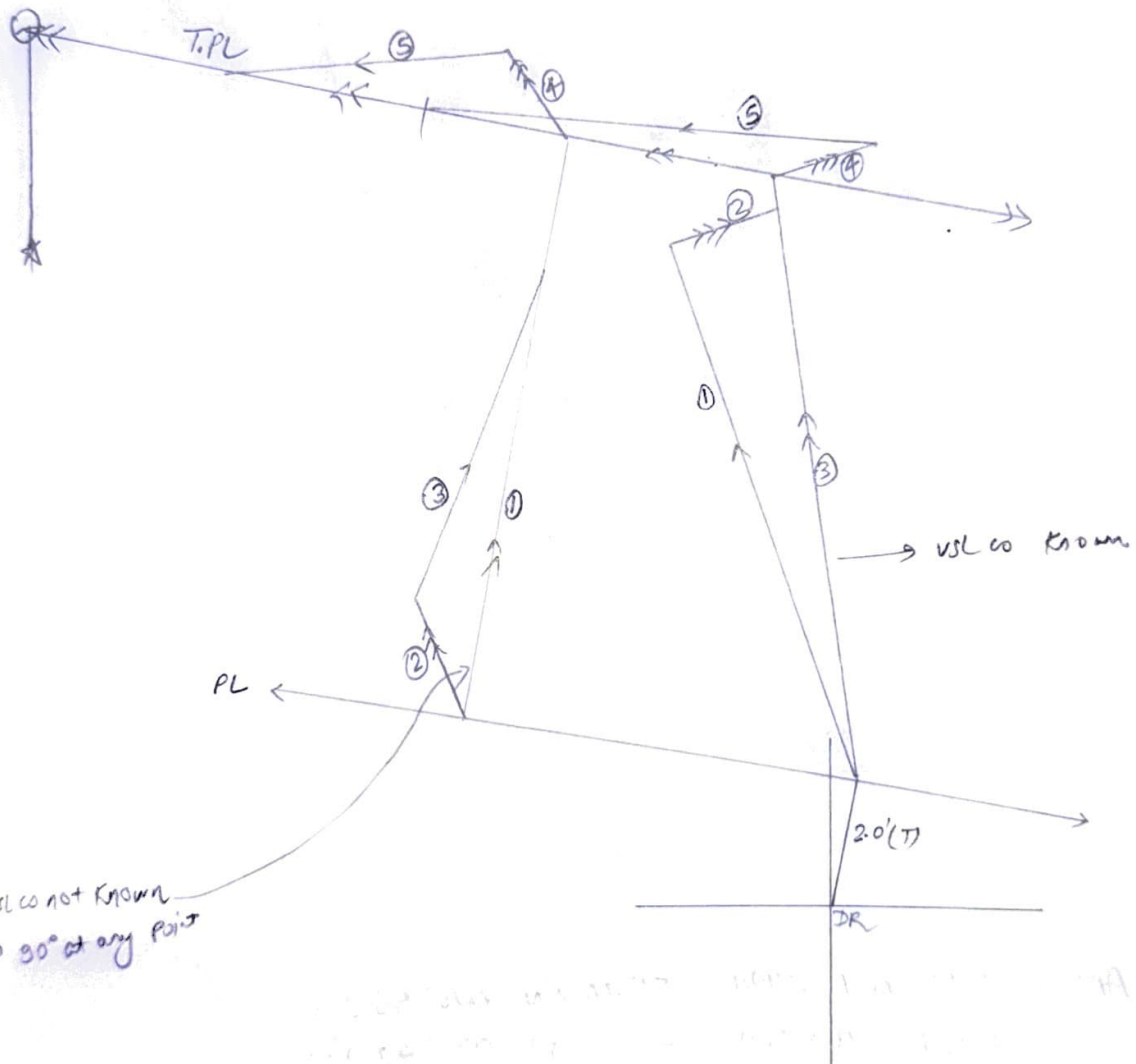


Ans:- 1014 hrs position : $51^{\circ}46.2'N$ $006^{\circ}56.0'W$

0812 hrs position: $52^{\circ} 05.8'N$ $006^{\circ} 42.0'W$

$$CE = 12^\circ W$$

BLIND NAVIGATION



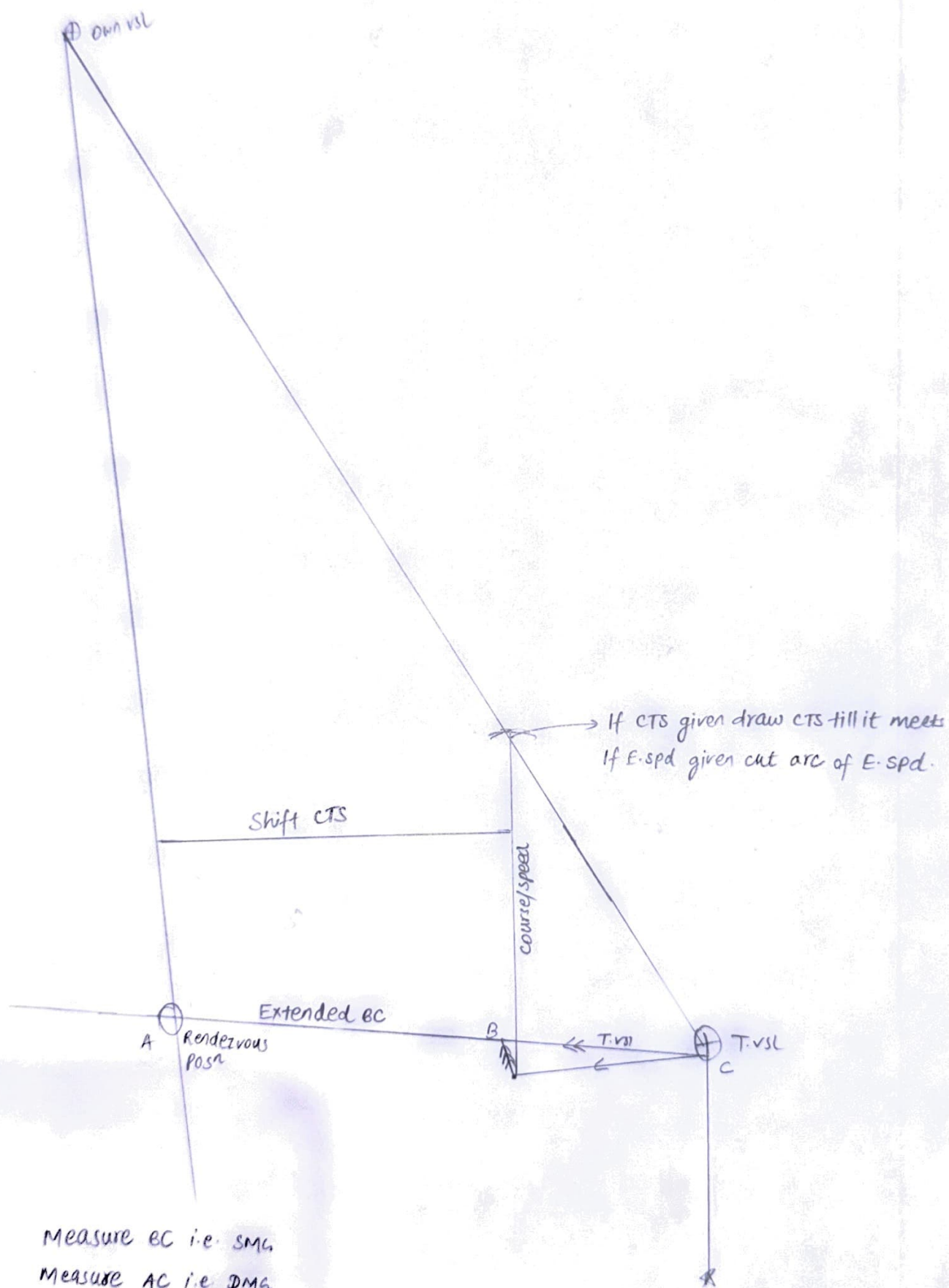
If VSL is not known
Draw 90° at any Point

VSL is known

20' (T)

DR

RENDEZVOUS (JULY 2018)



Measure BC i.e. SMG

Measure AC i.e. DMG

Time when rendezvous = $\frac{DMG}{SMG}$