IB MATHS AI SL · UNIT 3

Three-Figure Bearings and Navigation: exam practice

10 questions · 40 marks · worked solutions and markschemes

Name _____ Date _____ Score / 40

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/slai/three-figure-bearings-and-navigation-exam-practice

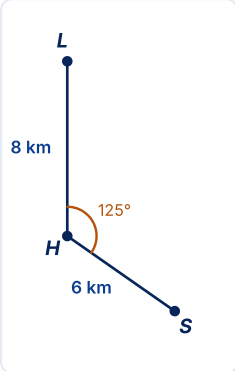
1. **1 mark · Paper 1 style · calculator allowed**

The bearing of B from A is $070°$. Write down the bearing of A from B. **[1]**

2. **3 marks · Paper 2 style · calculator allowed**

A lighthouse L is 8 km due north of a harbour H. A ship S is 6 km from H on a bearing of $125°$.

Find the distance from the ship to the lighthouse. **[3]**



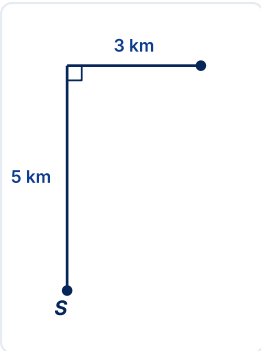
HL = 8 km north; HS = 6 km on 125°

3. **4 marks · Paper 1 style · calculator allowed**

Sam walks 5 km due north and then 3 km due east.

(a) Find how far Sam is from the start. **[2]**

(b) Find the bearing of Sam from the start. **[2]**



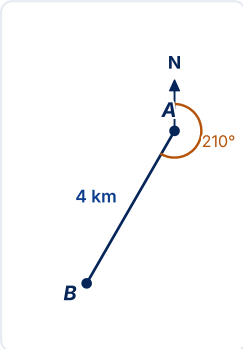
5 km north, then 3 km east

4. **3 marks · Paper 1 style · calculator allowed**

A hiker walks 4 km from A to B on a bearing of $210°$.

(a) Write down the bearing of A from B. **[1]**

(b) Find how far south of A the point B is. **[2]**



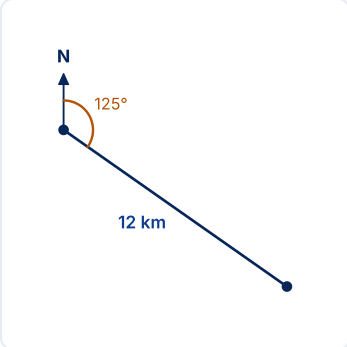
A to B: 4 km on 210°

5. **4 marks · Paper 1 style · calculator allowed**

A ship sails 12 km on a bearing of $125°$.

(a) Find how far east of its starting point it is. **[2]**

(b) Find how far south of its starting point it is. **[2]**



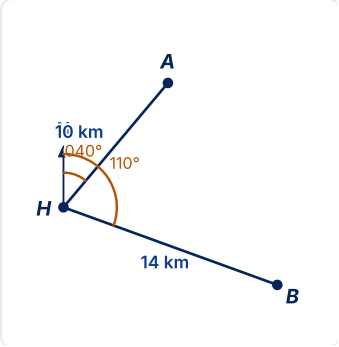
12 km on 125°

6. **4 marks · Paper 2 style · calculator allowed**

Two boats leave a harbour at the same time. Boat A sails 10 km on a bearing of $040°$ and boat B sails 14 km on a bearing of $110°$.

(a) Write down the angle between the two paths at the harbour. **[1]**

(b) Find the distance between the boats. **[3]**



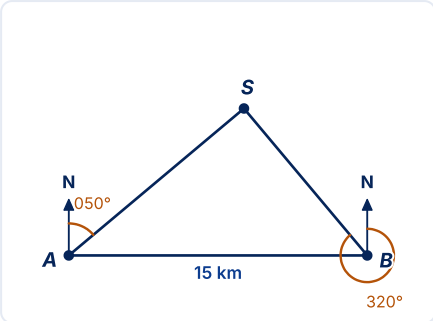
A: 10 km on 040°; B: 14 km on 110°

7. **4 marks · Paper 2 style · calculator allowed**

Lighthouse B is 15 km due east of lighthouse A. A ship S is on a bearing of $050°$ from A and on a bearing of $320°$ from B.

(a) Show that angle $A\hat{S}B = 90°$. **[2]**

(b) Find the distance from A to the ship. **[2]**



AB = 15 km; bearings 050° and 320°

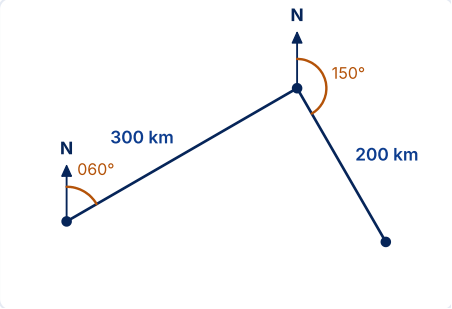
8. **5 marks · Paper 2 style · calculator allowed**

A plane flies 300 km on a bearing of $060°$, then 200 km on a bearing of $150°$.

(a) Show that the plane turns through a right angle. **[1]**

(b) Find the distance of the plane from its starting point. **[2]**

(c) Find the bearing of the plane from its starting point. **[2]**

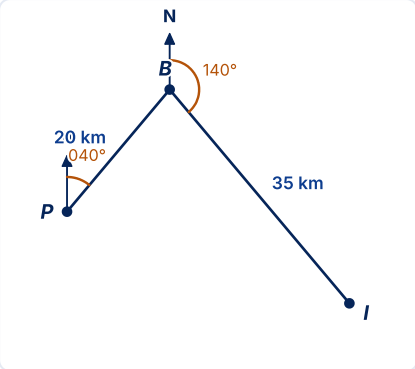


300 km on 060°, then 200 km on 150°

9. **6 marks · Paper 2 style · calculator allowed**

A boat leaves a port P and sails $20\ \text{km}$ on a bearing of $040°$ to a buoy B. It then turns and sails $35\ \text{km}$ on a bearing of $140°$ to an island I.

1. Calculate the size of the angle PBI.
2. Use the cosine rule to calculate the direct distance from the port P to the island I.



20 km on 040°, then 35 km on 140°

10. **6 marks · Paper 2 style · calculator allowed**

Two coastguard vessels, Alpha and Beta, leave the same dock at 12:00. Alpha travels at a speed of $15\ \text{km/h}$ on a bearing of $050°$. Beta travels at a speed of $22\ \text{km/h}$ on a bearing of $125°$.

1. Calculate the distance each vessel has travelled by 14:30.
2. Calculate the distance between the two vessels at 14:30.

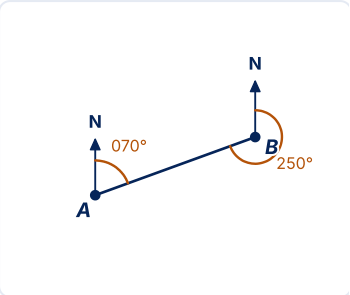
Answers and worked solutions

Question 1

1 mark

Answer: $250°$

$250°$ A1



Back bearing: add $180°$

Question 2

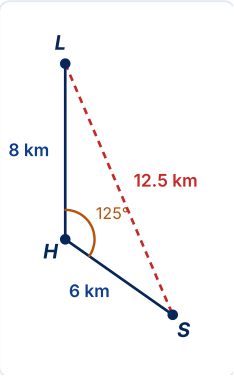
3 marks

Answer: 12.5 km

angle $L\hat{H}S = 125°$ (A1)

$LS^2 = 8^2 + 6^2 - 2(8)(6)\cos 125°$ (M1)

12.5 km A1



LS by the cosine rule: 12.5 km

Question 3

4 marks

Answer: (a) 5.83 km; (b) $031°$ ($31.0°$)

(a)

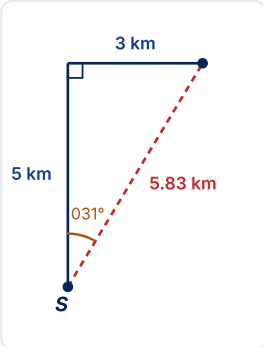
$\sqrt{5^2 + 3^2}$ (M1)

5.83 km A1

(b)

$\tan\theta = \frac{3}{5}$ (M1)

$031°$ A1



Distance 5.83 km on a bearing of $031°$

Question 4

3 marks

Answer: (a) $030°$; (b) 3.46 km

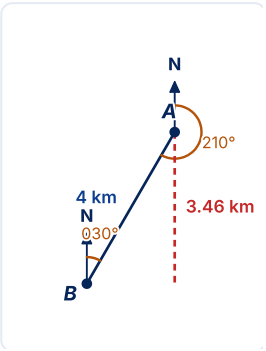
(a)

$030°$ A1

(b)

$4\cos 30°$ (M1)

3.46 km A1



Back bearing $030°$; 3.46 km south

Question 5

4 marks

Answer: (a) 9.83 km; (b) 6.88 km

(a)

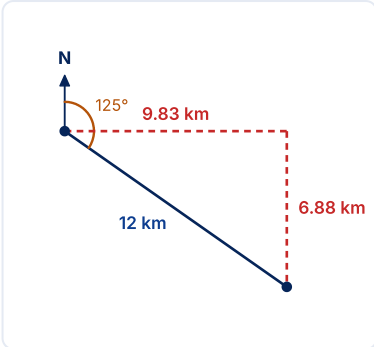
$12\sin 55°$ or $12\cos 35°$ (M1)

9.83 km A1

(b)

$12\cos 55°$ (M1)

6.88 km A1



East 9.83 km, south 6.88 km

Question 6

4 marks

Answer: (a) $70°$; (b) 14.2 km

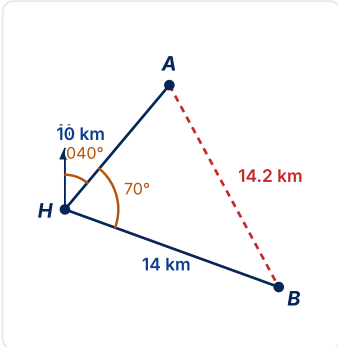
(a)

$70°$ A1

(b)

$d^2 = 10^2 + 14^2 - 2(10)(14)\cos 70°$ $M1A1$

14.2 km A1



Angle $AHB = 70°$; $AB = 14.2$ km

Question 7

4 marks

Answer: (b) 11.5 km

(a)

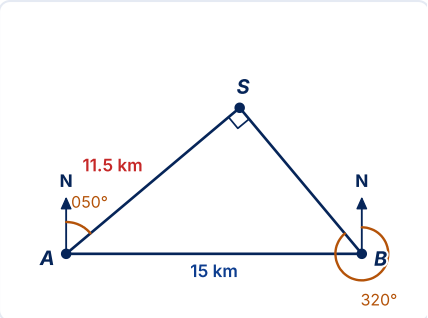
$S\hat{A}B = 90° - 50° = 40°$, $S\hat{B}A = 320° - 270° = 50°$ M1

$180° - 40° - 50° = 90°$ A1 AG

(b)

$15\cos 40°$ (M1)

11.5 km **A1**



Right angle at S; AS $= 11.5$ km

Question 8

5 marks

Answer: (b) 361 km; (c) $093.7°$

(a)

$150° - 60° = 90°$ **R1**

(b)

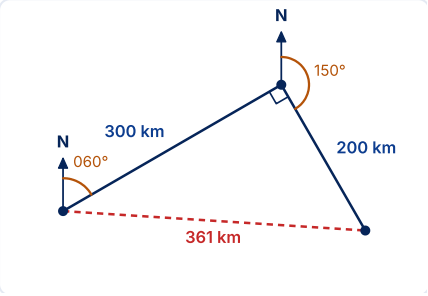
$\sqrt{300^2 + 200^2}$ **(M1)**

361 km **A1**

(c)

$60° + \tan^{-1}\left(\frac{200}{300}\right)$ **(M1)**

$093.7°$ **A1**



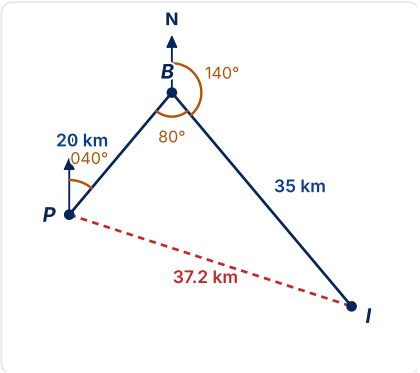
A right-angled turn; distance 361 km

Question 9

6 marks

Answer: (a) $80°$; (b) 37.2

1. Back bearing of P from $B = 040° + 180°$ **M1**
   $= 220°$ **A1**
   Angle $PBI = 220° - 140° = 80°$
   A1
2. Cosine rule:
   $PI^2 = 20^2 + 35^2 - 2(20)(35)\cos(80°)$
   M1
   $PI^2 = 400 + 1225 - 1400(0.1736\ldots) = 1381.8\ldots$
   (A1)
   $PI = \sqrt{1381.8\ldots} \approx 37.2$ km
   A1



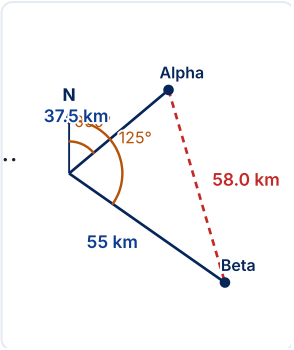
Angle $PBI = 80°$; $PI = 37.2$ km

Question 10

6 marks

Answer: (a) Alpha) 37.5; (a) Beta) 55; (b) 58.0

1. Time from 12:00 to 14:30 $= 2.5$ hours. Distance Alpha
   $= 15 \times 2.5 = 37.5$ km
   M1
   Distance Beta
   $= 22 \times 2.5 = 55$ km **A1**
2. Angle between their paths
   $= 125° - 050° = 75°$
   A1
   Cosine rule:
   $d^2 = 37.5^2 + 55^2 - 2(37.5)(55)\cos(75°)$
   M1
   $d^2 = 1406.25 + 3025 - 4125(0.2588\ldots) = 3363.6\ldots$
   (A1)
   $d = \sqrt{3363.6\ldots} \approx 58.0$ km
   A1



Distances after 2.5 hours

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