HIGHER

4.16H Bearings: Higher Tier Practice

Total Marks

EDEXCEL Edexcel 1MA1 · Calculator allowed · about 75 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A ship sails from point P on a bearing of 075 degrees for 24 km, then turns and sails on a bearing of 190 degrees for 16 km to point Q. Work out the bearing of Q from P, correct to the nearest degree.

(Total for Question 1 is 2 marks)

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2 From the summit of Beacon Hill, a ranger spots two landmarks, X and Y. The bearing of X from the summit is 032 degrees and the bearing of Y from the summit is 298 degrees. The ranger walks 4.2 km due south to a trig point T, then measures the bearing of X from T as 012 degrees.

(a) Write down the bearing of T from the summit. (1 mark)

(b) Hence or otherwise, find the distance from T to X, giving your answer to 3 significant figures.

(a) Write down the bearing of T from the summit. **(1)**

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(b) Hence or otherwise, find the distance TX to 3 significant figures. **(2)**

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(Total for Question 2 is 3 marks)

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3 A surveyor places two stakes A and B on level ground. From stake A the bearing of B is 142 degrees. From stake B the bearing of a tree T is 047 degrees. The distance AB is 360 m and the bearing of the tree T from A is 072 degrees.

Work out the distance from B to T, giving your answer to the nearest metre.

4 A lifeboat station L is offshore. A yacht Y is due east of L at a distance of 12 km. A search aircraft flies from L on a bearing of 055 degrees for 9 km to point P. From P the pilot reports the bearing of the yacht as 138 degrees. Calculate the distance from the aircraft (at P) to the yacht, giving your answer to 3 significant figures.

(Total for Question 4 is 5 marks)

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5 Two landmarks M and N are on level ground. From M the bearing of N is 067 degrees. From N the bearing of a windmill W is 320 degrees. From M the bearing of the windmill W is 102 degrees. A surveyor measures MN = 7.20 km. Work out the distance from M to the windmill W, giving your answer to 3 significant figures.

(Total for Question 5 is 5 marks)

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6 Show that if two points A and B have the same northing (i.e. lie on the same east-west line) and a third point C has bearing 090 degrees from A and bearing 270 degrees from B, then AC + BC = AB. You must give a clear geometric argument and state any angle facts used. (6 marks)

(Total for Question 6 is 6 marks)

7 A drone is at point D. Two towers T1 and T2 are located so that the bearing of T1 from D is 015 degrees and the bearing of T2 from D is 120 degrees. From T1 the bearing of T2 is 170 degrees, and a ground crew measure the distance between the two towers as 9.6 km. From T1 the bearing of a mast M is 210 degrees and from T2 the bearing of M is 330 degrees. Using all this information, calculate the distance from D to the mast M. Give your answer to 3 significant figures. (8 marks)

(Total for Question 7 is 8 marks)

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8 Generalisation problem. Points A and B are two fixed points. A point P moves so that the bearing of P from A is fixed at θ degrees and the bearing of P from B is fixed at φ degrees, where θ and φ are given acute angles such that a consistent position of P exists. Explain briefly what geometric locus P describes and give one condition on θ and φ (in words) that must hold for P to lie on a finite locus. (7 marks)

(Total for Question 8 is 7 marks)

Mark scheme · 4.16H Bearings: Higher Tier Practice

Question 1

- **M1** Resolve each leg into northing and easting components or equivalent vector method showing displacement from P to Q
- **A1** bearing 115 degrees cao
- **Answer: 115 degrees**

Question 2

- (a) **B1** bearing 180 degrees cao
- **(a) Answer: 180 degrees**
- (b) **M1** Use triangle between summit S, T and X: angle at S between ST (bearing 180) and SX (bearing 032) = 180 - 32 = 148 degrees; bearing T to S is the reverse of S to T, i.e. 000, so angle at T between TS (000) and TX (012) = 12 degrees; angle at X = 180 - 148 - 12 = 20 degrees
- (b) **A1** TX = 6.51 km awrt 3 sig figs
- **(b) Answer: 6.51 km**

Question 3

- **M1** Use bearings to find interior angles of triangle ABT: angle at A = bearing AB (142) - bearing AT (072) = 70 degrees
- **M1** Find angle at B using bearings: bearing from B to A is 322 degrees, to T is 047, so interior angle at B = 047 - 322 adjusted = 85 degrees
- **M1** Find third angle at T = 180 - 70 - 85 = 25 degrees and set up sine rule relating BT to AB
- **A1** BT = 800 m cao (nearest metre)
- **Answer: 800 m**

Question 4

- **M1** Place L at origin and Y at (12, 0); find coordinates of P: Px = 9*sin55, Py = 9*cos55
- **M1** Find vector from P to Y: (12 - Px, 0 - Py) and compute components
- **M1** Use bearing from P to Y (138 degrees, as given) to confirm direction quadrant or to check sign of components
- **A1** Distance PY = $\sqrt{(12 - Px)^2 + (0 - Py)^2}$ cao
- **B1** final answer 6.93 km awrt 3 s.f.
- **Answer: PY = 6.93 km**

Question 5

- **M1** Find angle at M between MN (067) and MW (102): 102 - 067 = 35 degrees
- **M1** Calculate angle at N: bearing from N to M is 067 + 180 = 247 degrees, bearing from N to W is 320 degrees so interior angle at N = 320 - 247 = 73 degrees
- **M1** Find third angle at W = 180 - 35 - 73 = 72 degrees
- **M1** Apply sine rule correctly to find MW: MW/sin(N) = MN/sin(W), so MW = MN * sin(73) / sin(72)
- **A1** MW = 7.24 km awrt 3 s.f.
- **Answer: 7.24 km**

Question 6

- **M1** State that A and B lie on same east-west line so their northings are equal and AB is horizontal
- **M1** Interpret bearings: C is on a line due east of A (bearing 090 from A) and due west of B (bearing 270 from B)
- **M1** Conclude that C also lies on the same horizontal line as A and B (C has the same northing as A and B), so A, C and B are collinear
- **M1** State that since C is east of A and west of B, C must lie between A and B on this shared line (not beyond either end)
- **A1** Conclude AC + CB = AB, since C lies on the segment AB, with a clear reason cao
- **B1** Full, logical explanation using angle facts (090/270 bearings give directions along the same east-west line) leading to AC + CB = AB
- **Answer: As above: AC + CB = AB, since C lies between A and B on the shared east-west line.**

Question 7

- **M1** Use bearings from D to find angle T1DT2 = 120 - 015 = 105 degrees
- **M1** Use the bearing T1 to T2 (170) with the back bearing T1 to D (015 + 180 = 195) to find angle DT1T2 = 195 - 170 = 25 degrees, hence angle DT2T1 = 180 - 105 - 25 = 50 degrees
- **M1** Apply sine rule in triangle D-T1-T2: DT1 = 9.6*sin(50)/sin(105) = 7.61 km, DT2 = 9.6*sin(25)/sin(105) = 4.20 km
- **M1** Find angle MT1T2 = bearing T1->M (210) - bearing T1->T2 (170) = 40 degrees, and angle MT2T1 = back bearing T2->T1 (350) - bearing T2->M (330) = 20 degrees, hence angle T1MT2 = 180 - 40 - 20 = 120 degrees
- **M1** Apply sine rule in triangle T1-T2-M to find T1M = 9.6*sin(20)/sin(120) = 3.79 km
- **A1** Find angle DT1M = bearing T1->M (210) - bearing T1->D (195) = 15 degrees, then use the cosine rule in triangle D-T1-M: $DM^2 = DT1^2 + T1M^2 - 2*DT1*T1M*\cos(15)$
- **A1** Carry out the calculation correctly: $DM^2 = 7.61^2 + 3.79^2 - 2*7.61*3.79*\cos15 = 16.6$
- **B1** Final answer 4.07 km awrt 3 s.f.
- **Answer: 4.07 km**

Question 8

- **M1** State that a fixed bearing from A is a ray from A at angle θ; similarly from B
- **M1** Recognise that intersection of two rays is either a single point or empty, so locus is typically a point if the rays meet
- **M1** Explain that if θ and φ vary to describe whole sets of bearings then locus could be an arc; here with fixed θ and φ the locus is the intersection point (or none)
- **M1** State a condition for a finite locus in words: the two rays from A and B must meet, i.e. not be parallel and must be directed so they cross
- **A1** Give an explicit condition example: θ and φ must not differ by 180 degrees and the directions must face towards each other so the rays intersect
- **A1** Provide a short diagrammatic or verbal justification
- **B1** Concise concluding sentence describing locus as either a single point (when rays meet) or empty, with condition stated
- **Answer: The locus is the intersection of two rays so usually a single point; requirement: the two rays must meet (not be parallel or pointing away from each other).**