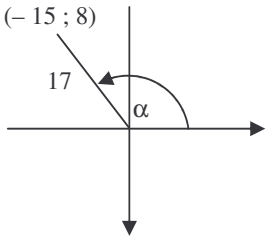
- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

QUESTION 8

8.1	$\sin\alpha = \frac{8}{17}$ $\sin\alpha > 0 \therefore$ in second quadrant $y_\alpha = 8 \quad r_\alpha = 17$ $x_\alpha = -15 \quad (\text{Pythagoras})$ $\tan\alpha = -\frac{8}{15}$  	$x = -$✓15✓ ✓ answer (3) For drawing the radius vector in the correct quadrant 1/3 Without a sketch but correct values: 3/3
8.2	$\sin(90° + \alpha) = \cos\alpha$ $= -\frac{15}{17}$	✓ reduction ✓ answer (2) Answer only: full marks Cannot accept decimal values
8.3	$\cos 2\alpha = 1 - 2\sin^2\alpha$ $= 1 - 2\left(\frac{8}{17}\right)^2$ $= \frac{161}{289}$ **OR** $\cos 2\alpha = 2\cos^2\alpha - 1$ $= 2\left(\frac{-15}{17}\right)^2 - 1$ $= \frac{161}{289}$ **OR** $\cos 2\alpha = \cos^2\alpha - \sin^2\alpha$ $= \left(\frac{-15}{17}\right)^2 - \left(\frac{8}{17}\right)^2$ $= \frac{161}{289}$	✓ expansion ✓ substitution ✓ any further calculation or answer (3) ✓ expansion ✓ substitution ✓ any further calculation or answer (3) ✓ expansion ✓ substitution ✓ any further calculation or answer (3) **[8]**

- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

QUESTION 9

NOTE: Only penalise once in the question for leaving out the x
Penalise once in this question for treating as an equation

9.1	$\sin(90°-x).\cos(180°-x)+\tan x.\cos(-x).\sin(180°+x)$ $=\cos x(-\cos x)+\tan x(\cos x)(-\sin x)$ $=-\cos^2 x-\frac{\sin x}{\cos x}\cos x\sin x$ $=-\cos^2 x-\sin^2 x$ $=-(\cos^2 x+\sin^2 x)$ $=-1$	✓ $\sin(90°-x)=\cos x$ ✓ $\cos(180°-x)=-\cos x$ ✓ $\cos(-x)=\cos x$ ✓ $\sin(180°+x)=-\sin x$ ✓ $\tan x=\frac{\sin x}{\cos x}$ ✓ simplification ✓ answer (7)
9.2	$\frac{\sin 190°\cos 225°\tan 390°}{\cos 100°\sin 135°}$ $=\frac{-\sin 10°(-\cos 45°)\tan 30°}{-\sin 10°\sin 45°}$ $=\frac{-\frac{1}{\sqrt{2}}.\frac{1}{\sqrt{3}}}{\frac{1}{\sqrt{2}}}$ or $=-\tan 30°$ $=-\frac{1}{\sqrt{3}}$ If using – cos 80° : no penalty If the candidate stop at $=\frac{-\frac{1}{\sqrt{2}}.\frac{1}{\sqrt{3}}}{\frac{1}{\sqrt{2}}}$ 6/7	✓ $\sin 190° = -\sin 10°$ ✓ $\cos 225° = -\cos 45°$ ✓ $\tan 390° = \tan 30°$ ✓ $\cos 100° = -\sin 10°$ ✓ $\sin 135° = \sin 45°$ or $\cos 45°$ ✓✓ substitution (7)
9.3	$\sin x+2\cos^2 x=1$ $\sin x+2(1-\sin^2 x)=1$ $-2\sin^2 x+\sin x+1=0$ $2\sin^2 x-\sin x-1=0$ $(2\sin x+1)(\sin x-1)=0$ $\sin x=1$ $x=90°+k.360°;k\in Z$ Or	✓ substitution of identity ✓ standard form ✓ factorisation ✓ $\sin x=1;\sin x=-\frac{1}{2}$ ✓ $x=90°+k.360°;k\in Z$ ✓✓ answers (any two answers) (7) If $k\in Z$ not included: 6/7 Also ± $k.360°;k\in N_0$ *or* Z

- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

$\sin x = -\frac{1}{2}$

$x = 210° + k.360°; k \in Z$ *OR* $x = 210° + k.360°$
or $x = 330° + k.360°; k \in Z$ *or* $x = -30° + k.360°$
OR
$x = -150° + k.360°; k \in Z$ OR $x = -150° + k.360°; k \in Z$
or $x = 330° + k.360°$ *or* $x = -30° + k.360°$

✓ manipulation
✓ substitution of identity

✓ co ratios

OR

$\sin x + 2\cos^2 x = 1$
$\sin x = 1 - 2\cos^2 x$
$\sin x = -\cos 2x$
$\sin x = -[\sin(90° - 2x)]$
$x = 180° + (90° - 2x) + k360°$
$3x = 270° + k360°$ or $x = 360° - (90° - 2x) + k360°$
$x = 90° + k120°$ $x = -270° - k360°$
$k \in Z$

✓ $x = 180° + (90° - 2x) + k360°$
✓ $x = 90° + k120°$
✓ $x = 360° - (90° - 2x) + k360°$
✓ $x = -270° - k360°$

(7)

If $k \in Z$ not included: 6/7

OR

$\sin x + 2\cos^2 x = 1$
$\sin x = 1 - 2\cos^2 x$
$\sin x = -\cos 2x$
$-\cos(90° - x) = \cos 2x$
$2x = 180° - (90° - x) + k360°$ or $2x = 180° + (90° - x) + k360°$
$x = 90° + k360°$ $3x = 270° + k360°$
$x = 30° + k120°$
$k \in Z$

✓ manipulation
✓ substitution of identity

✓ co ratios

✓ $2x = 180° - (90° - x) + k360°$
✓ $x = 90° + k360°$
✓ $2x = 180° + (90° - x) + k360°$
✓ $x = 30° + k120°$

(7)

If $k \in Z$ not included: 6/7

[20]

- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

QUESTION 10

10.1

$$\frac{\sin(A+B)}{\cos(A+B)} = \frac{\sin A.\cos B + \cos A.\sin B}{\cos A.\cos B - \sin A.\sin B}$$

$$= \frac{\sin A.\cos B + \cos A.\sin B}{\cos A.\cos B - \sin A.\sin B} \times \frac{\frac{1}{\cos A.\cos B}}{\frac{1}{\cos A.\cos B}}$$

$$= \frac{\frac{\sin A.\cos B}{\cos A.\cos B} + \frac{\cos A.\sin B}{\cos A.\cos B}}{\frac{\cos A.\cos B}{\cos A.\cos B} - \frac{\sin A.\sin B}{\cos A.\cos B}}$$

$$= \frac{\tan A + \tan B}{1 - \tan A.\tan B}$$

✓ expansions

✓ divisions

✓ tanA and tanB (3)

OR

$$RHS = \frac{\tan A + \tan B}{1 - \tan A.\tan B}$$

$$= \frac{\frac{\sin A}{\cos A} + \frac{\sin B}{\cos B}}{1 - \frac{\sin A}{\cos A}\frac{\sin B}{\cos B}} \times \frac{\cos A.\cos B}{\cos A.\cos B}$$

$$= \frac{\sin A\cos B + \sin B\cos A}{\cos A\cos B - \sin A\sin B}$$

$$= \frac{\sin(A+B)}{\cos(A+B)}$$

$$= \tan(A+B)$$

$$= \text{LHS}$$

✓ $\frac{\sin A}{\cos A}$

✓ multiplication

✓ expansions (3)

10.2

$$\tan C = \tan(180° - (A+B))$$

$$\tan C = -\tan(A+B)$$

$$\tan C = -\left(\frac{\tan A + \tan B}{1 - \tan A.\tan B}\right)$$

$$\tan C(1 - \tan A.\tan B) = -(\tan A + \tan B)$$

$$\tan C - \tan A.\tan B.\tan C = -\tan A - \tan B$$

$$\tan A + \tan B + \tan C = \tan A.\tan B.\tan C$$

OR

✓ C

✓ $-\tan(A+B)$

✓ substitution into formula

✓ multiplication with LCD (4)

If no conclusion: 3/4

- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

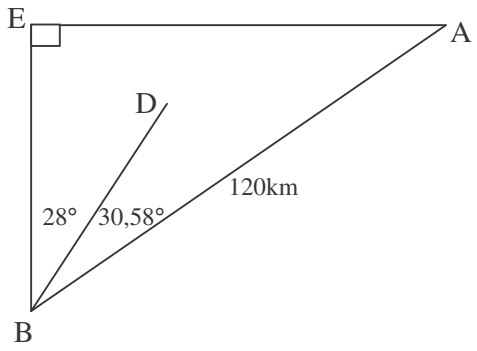
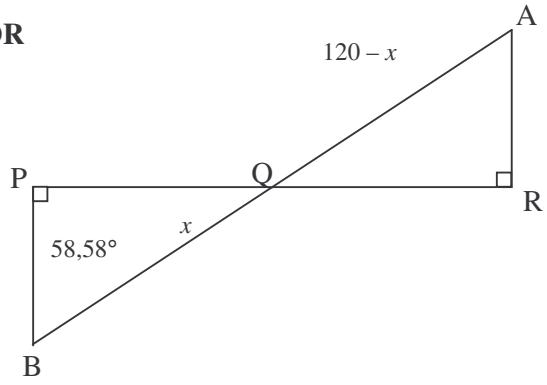
	$\hat{C} = 180° - (\hat{A} + \hat{B})$ (angles in a triangle) $\tan C = \tan(180° - (A + B))$ $\tan C = \tan((180° - A) + (-B))$ $\tan C = \dfrac{\tan(180° - A) + \tan(-B)}{1 - \tan(180° - A).\tan(-B)}$ $\tan C(1 - \tan(180° - A).\tan(-B)) = \tan(180° - A) + \tan(-B)$ $\tan C - \tan C \tan A \tan B = -\tan A - \tan B$ $\tan A + \tan B + \tan C = \tan A.\tan B.\tan C$	✓ C ✓ rearrange angle ✓ substitution into formula ✓ expansion (4)

QUESTION 11

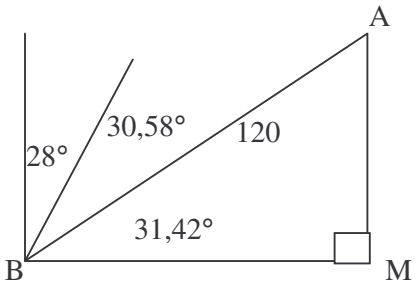
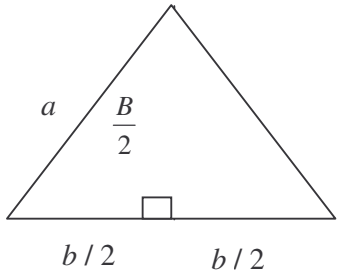
NOTE: Penalty of one for early rounding off once in this question

11.1.1	$B\hat{D}A = 208° - 67°$ $= 141°$ $\dfrac{\sin D\hat{B}A}{97} = \dfrac{\sin 141°}{120}$ $\sin D\hat{B}A = 0,5087006494...$ $D\hat{B}A = 30,58°$ $\therefore$ Bearing of Ship A from Ship B $= 180° - (360° - 208°) + 30,58°$ $= 58,58°$	✓ $B\hat{D}C = 141°$ ✓ sine rule ✓ substitution ✓ $\hat{B} = 30,58°$ ✓ method or $M\hat{B}D = 28°$ ✓ answer (6)
	OR $B\hat{D}A = 208° - 67°$ $= 141°$ $\dfrac{\sin D\hat{B}A}{97} = \dfrac{\sin 141°}{120}$ $\sin D\hat{B}A = 0,5087006494....$ $D\hat{B}A = 30,58°$ *then* $360° - 208° = N\hat{D}B$ (reflex angles) $\therefore N\hat{D}B = 152°$ *but* $M\hat{B}D + N\hat{D}B = 180°$ (co - interior angles/ angles around a point) $\therefore M\hat{B}D = 28°$ *then* $M\hat{B}A = M\hat{B}D + D\hat{B}A$ $= 30,58° + 28°$ $= 58,58°$	✓ $B\hat{D}C = 141°$ ✓ sine rule ✓ substitution ✓ $N\hat{D}B = 152°$ ✓ $M\hat{B}D = 28°$ ✓ answer (6)

- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

11.1.2	$\hat{B} = 30,58°$  $\frac{EA}{120} = \sin(28° + 30,58°)$ $EA = 120\sin(28° + 30,58°)$ $EA = 102,4$ km **OR**  Let BQ = x, then AQ = $120 - x$ $\sin 58,58° = \frac{PQ}{x}$ $\sin 58,58° = \frac{QR}{120 - x}$ $PQ = x.\sin 58,58°$ $QR = (120 - x)\sin 58,58°$ $PQ + QR = x.\sin 58,58° + (120 - x)\sin 58,58°$ $= 120\sin 58,58°$ $= 102,4$ **OR** BP = AR (assume ships move at same speed)	✓ definition ✓ substitution ✓ answer (3) ✓ trigonometeric ratios ✓ sum ✓ answer (3) ✓ trigonometeric

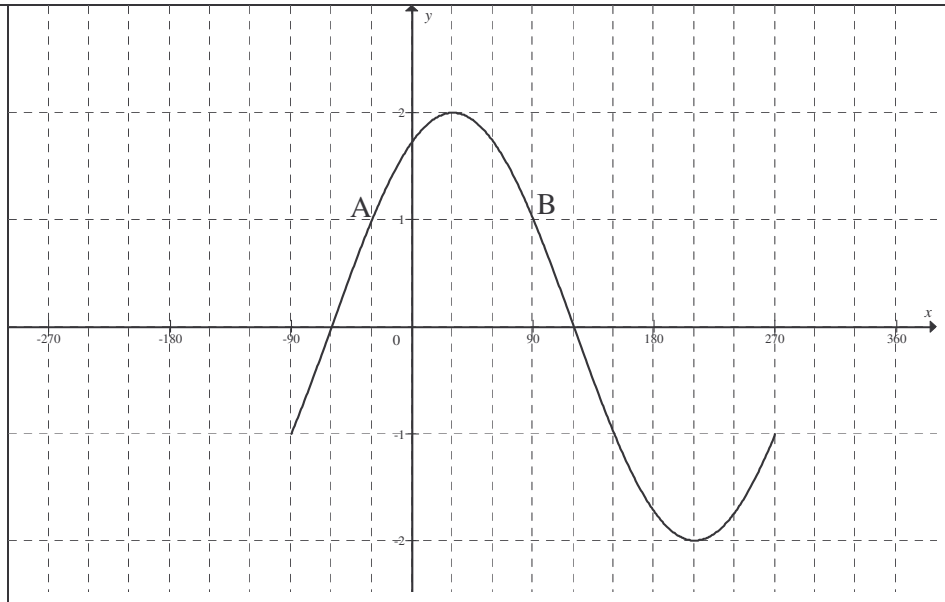
- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

	$\Delta PBQ \equiv \Delta RAQ$ (angle, angle, side) $\therefore$ BQ = QA = 60 km $\sin 58{,}58° = \frac{PQ}{60}$ $\therefore PQ = 60 \sin 58{,}58°$ $= 51{,}20$ km PR = 2PQ $= 102{,}4$ km OR $\frac{BM}{120} = \cos 31{,}42$ $BM = 120 \times \cos 31{,}42°$ $= 102{,}4$  	ratios ✓ 51,20 km ✓ answer (3) ✓ trigonometeric ratios ✓ substitution ✓ answer (3)
11.2	AB = BC = a = c $b^2 = a^2 + c^2 - 2ac \times \cos B$ $b^2 = a^2 + a^2 - 2a \times a \times \cos B$ $b^2 = 2a^2 - 2a^2 \cos B$ $b^2 = 2a^2(1 - \cos B)$ $\frac{b^2}{2a^2} = 1 - \cos B$ $\cos B = 1 - \frac{b^2}{2a^2}$ **OR** $\sin \frac{B}{2} = \frac{b}{2a}$ $\cos B = 1 - 2\sin^2 \frac{B}{2}$ $= 1 - 2\left(\frac{b}{2a}\right)^2$ $= 1 - \frac{b^2}{2a^2}$  	✓ equal sides ✓ cos rule ✓ substitution ✓ simplification (4) ✓ $\sin \frac{B}{2}$ ✓ $\sin \frac{B}{2} = \frac{b}{2a}$ ✓ formula ✓ substitution (4) **[13]**

- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

	OR $\cos B = \frac{a^2 + c^2 - b^2}{2ac}$ *but* $a = c$ $\cos B = \frac{a^2 + a^2 - b^2}{2a.a}$ $= \frac{2a^2 - b^2}{2a^2}$ $= 1 - \frac{b^2}{2a^2}$	✓ cos rule ✓ equal sides ✓ substitution ✓ simplification (4)

QUESTION 12

12.1		✓ (120°; 0) or (–60°; 0) ✓ (30°; 2) or (210°; – 2) (2)

- Consistent Accuracy will apply as a general rule.
- If a candidate does a question twice and does not delete either, mark the FIRST attempt.
- If a candidate does a question, crosses it out and does not re-do it, mark the deleted attempt.

QUESTION 12

12.2	$\cos(x-30°)=\frac{1}{2}$ $2\cos(x-30°)=1$ See points A and B on the graph **Note:** If drawn the line y = $\frac{1}{2}$ and put A and B on the graph: 0/2 If A and B on the *x*-axis: 1/2 If A= $-30°$ and B = $90°$: 1/2	✓manipulation ✓ answer (2) A and B in the correct place on the graph: full marks
12.3	$\cos(x-30°)=0,5$ $x-30°=60°$ OR $x-30°=-60°$ $x=90°$ $x=-30°$	✓ 60° (ref angle) ✓ 90° ✓ – 30° (3) Answer only: 3/3
12.4	$g'(x)=0$ is at maximum and minimum values of graph $x = 30°; 210°$	✓✓ one for each *x*-value (2)
12.5	$x \in [-90° ; -60°) \cup (120° ; 270°]$ **OR** $-90° \le x < -60°$ or $120° < x \le 270°$ **OR** *If* $x<-60°$ *or* $x>120°$ 2/3	✓ notation ✓✓ critical values (3) **[12]**