(12)

$$2\sin 2x - \sin^2 x = 0$$

$$2(2\sin x\cos x) - \sin^2 x = 0$$

$$4\sin x\cos x - \sin^2 x = 0$$

$$(\sin x)(4\cos x - \sin x) = 0$$

$\sin x = 0$ or $4\cos x - \sin x = 0$

$\underline{x = 0°, 180°}$ or $\sin x = 4\cos x$

$$\frac{\sin x}{\cos x} = 4$$

$$\tan x = 4$$

Related acute angle $= \tan^{-1} 4$

$= 75.963\ldots$

$\approx 76.0°$

$x = 76.0°, 180 + 76.0°$

$\underline{x = 76.0°, 256.0°}$

Question			Generic scheme	Illustrative scheme	Max mark
12.			•1 substitute appropriate double angle formula •2 factorise •3 solve for $\tan x°$ •4 solve $\tan x° = 4$ •5 solve $\sin x° = 0$	•1 $2(2\sin x° \cos x°) - \sin^2 x° (= 0)$ •2 $\sin x° (4\cos x° - \sin x°) = 0$ •3 $\tan x° = 4$ (since $x = 90, 270$ are not solutions) •4 •5 •4 76, 256 •5 0, 180	5

Notes:

1. •1 is still available to candidates who correctly substitute for $\sin^2 x$ in addition to $\sin 2x$.
2. Substituting $2\sin A \cos A$ for $\sin 2x°$ at the •1 stage should be treated as bad form provided the equation is written in terms of x at the •2 stage. Otherwise, •1 is not available.
3. '$= 0$' must appear by the •2 stage for •2 to be awarded.
4. Award •2 for '$S(4C - S) = 0$' only where $\sin x° = 0$ and $4\cos x° - \sin x° = 0$ appear.
5. Do not penalise the omission of degree signs.
6. At •3 stage, candidates are not required to check that 90 and 270 are not solutions before dividing by $\cos x°$. Where candidates have divided by $\sin x$ at the •2 stage without considering $\sin x = 0$, •3 and •4 are still available.
7. At •3 stage, candidates may use the wave function and arrive at $\sqrt{17}\cos(x+14)° = 0$, or an equivalent wave form, instead of $\tan x° = 4$.
8. •4 is only available where the working at the •3 stage is of equivalent difficulty to reaching $\tan x° = 4$.
9. •5 is not available where $\sin x = 0$ comes from an invalid strategy.
10. For candidates who work only in radians, •5 is not available.
11. •4 and •5 may be awarded vertically. See also Candidate B.
12. Do not penalise solutions outwith $0 \le x < 360$.

Commonly Observed Responses:

Candidate A - working in radians		Candidate B - partial solutions	
⋮	•1 ✓ •2 ✓	$2(2\sin x° \cos x°) - \sin^2 x° = 0$	•1 ✓
$\tan x° = 4$	•3 ✓	$\sin x° (4\cos x° - \sin x°) = 0$	•2 ✓
1.326, 4.468	•4 ✓1	$\sin x° = 0$	
$0, \pi$	•5 ✓2	$x = 180$	
		$\tan x° = 4$	•3 ✓
		$x = 76$	•4 ✓
		•5 ^	