(14) $\underset{\sim}{u} \cdot (\underset{\sim}{u} + \underset{\sim}{v}) = 21$

$\underset{\sim}{u} \cdot \underset{\sim}{u} + \underset{\sim}{u} \cdot \underset{\sim}{v} = 21$

$|\underset{\sim}{u}||\underset{\sim}{u}| \cos\theta + |\underset{\sim}{u}||\underset{\sim}{v}| \cos\theta = 21$

$4 \times 4 \times \cos\theta + 4 \times 5 \times \cos\theta = 21$

$16 + 20\cos\theta = 21$

$20\cos\theta = 5$

$\cos\theta = \frac{5}{20}$

$\theta = 75.5^\circ$

Question			Generic scheme	Illustrative scheme	Max mark
14.			•1 expand •2 evaluate $\mathbf{u}.\mathbf{u}$ •3 determine equation in $\cos\theta$ •4 evaluate angle	•1 $\mathbf{u}.\mathbf{u}+\mathbf{u}.\mathbf{v}$ •2 16 •3 $20\cos\theta=5$ or $\cos\theta=\frac{5}{20}$ •4 $75{\cdot}5\ldots°$ or $1{\cdot}31\ldots$ radians	4

Notes:

1. Do not accept $\mathbf{u}^2$ for •1, however •2, •3 and •4 are still available.
2. Where there is no evidence for •1, then •2, •3 and •4 are not available, however see Candidates C and D.
3. Where candidates use $|\mathbf{u}|\neq 4$, then •3 and •4 are not available.
4. Where there is no evidence of using $|\mathbf{u}|^2$, •3 is not available. See Candidate A.
5. Do not penalise omission of units in final answer.
6. Ignore the appearance of $284{\cdot}5°$.
7. Accept answers which round to 76° or 1·3 radians.

Commonly Observed Responses:

Candidate A

$\mathbf{u}.(\mathbf{u}+\mathbf{v})=\mathbf{u}.\mathbf{u}+\mathbf{u}.\mathbf{v}$ •1 ✓

$4+20\cos\theta=21$ •2 ×

$\cos\theta=\frac{17}{20}$ •3 ✓ 2

$\theta=31{\cdot}7\ldots°$ •4 ✓ 1

Candidate B

$16+\mathbf{u}.\mathbf{v}=21$ •1 ✓ •2 ✓

$\mathbf{u}.\mathbf{v}=5$

$\cos\theta=\frac{5}{20}$ •3 ✓

$\theta=75{\cdot}5°$ •4 ✓

Candidate C – missing working

$\mathbf{u}.\mathbf{u}=16$ •2 ✓

$\mathbf{u}.\mathbf{v}=21-16$

$\cos\theta=\frac{5}{20}$ •1 ✓ •3 ✓

$\theta=75{\cdot}5°$ •4 ✓

Candidate D – missing working

$21-16=5$ •1 ^

$\cos\theta=\frac{5}{20}$ •2 ✓ •3 ✓

$\theta=75{\cdot}5°$ •4 ✓