Question Number	Scheme	Marks
8 (a)	$4p^2 - q^2 = (2p+q)(2p-q)$	B1
		(1)
(b)	Makes one valid statement :Either $\begin{matrix}2p+q=46\\2p-q=1\end{matrix}$ **or** $\begin{matrix}2p+q=23\\2p-q=2\end{matrix}$	M1
	Solves correctly one of the pairs (see notes): e.g. $2p+q=46,\ 2p-q=1 \Rightarrow\ p=11.75, (q=22.5)$ oe **or** e.g. $2p+q=23,\ 2p-q=2 \Rightarrow p=6.25, (q=10.5)$ oe	A1
	States and attempts to solve **both equations (see above)**	dM1
	Fully correct proof by contradiction requiring (1) correct set up, (2) correct solution of both equations and (3) correct conclusion *	A1*
		(4)
		Total 5

(a)

B1: Correct factorisation

Note on epen this is B1M1A1A1* but we are marking this M1A1dM1A1*

Mark the attempts at valid pairs of equations in the order which scores the most marks

(b) If you see any other proofs which appear to be credit worthy then send to review

M1: Deduces either of the valid pairs of equations. There is no requirement to justify that $2p+q$ must be greater than $2p-q$ and therefore solve the other possible equations. Ignore these attempts at these pairs of equations.

A1: Correctly solves one of the two valid pairs of equations. No working is required, just the correct solution. Note that it is acceptable to only go as far as finding either one of p or q as that is a non-integer. However, if they find the other one of p or q then they must both be correct. Beware that the correct solving may be their second valid pair.

Note if they only proceed to e.g. $4p=25$ **they must explain the contradiction** that e.g. p cannot be an integer **because** 25 is not divisible by 4 or LHS=even, RHS=odd or LHS=multiple of 4, RHS=not a multiple of 4

dM1: States and attempts to solve **both** valid pairs of equations. Condone proceeding as far as e.g. $4p=47$ for this mark. It is dependent on the previous method mark.

A1*: Full proof by contradiction. This must follow M1A1dM1

Look for

- a correct set up with words such as "assume there is" or "let there be" with "integers p and q"
- correct solution of **both** valid pairs of equations (and explanations where required e.g. if only proceeding as far as $4p=25$) If p and q are both found for both valid pairs then they must be correct.
- a (minimal) conclusion

Minimal proof for 4 marks:

Assume that there are integers p and q such that $4p^2 - q^2 = 46$

(So) $2p + q = 46$, $2p - q = 1 \Rightarrow p = 11.75$ not an integer

(and) $2p + q = 23$, $2p - q = 2 \Rightarrow p = 6.25$ not an integer

Hence, (we have a contradiction), so statement is proven

Alt(b) – using odd and even factor argument example

M1: Identifies that $46 = 1 \times 46,\ 2 \times 23$ **and** considers either the case when q is odd OR when q is even

- when q is odd then $(2p + q)$ is odd and $(2p - q)$ is odd OR
- when q is even then $(2p + q)$ is even and $(2p - q)$ is even

A1: Deduces correctly for the case when q is odd that 46 cannot be the product of two odd numbers OR deduces correctly for the case when q is even that 46 cannot be the product of two even numbers

dM1: Considers both cases (see first M1). It is dependent on the previous method mark

A1*: Full proof by contradiction. This must follow M1A1dM1

Look for

- a correct set up with words such as "assume there is" or "let there be" with "integers p and q"
- correct deductions for both odd and even cases
- a (minimal) conclusion

Alt(b) – condone using even property example

M1: e.g. $4p^2 - q^2 = 46 \left(\Rightarrow q^2 = 4p^2 - 46\right)$ and deduces q^2 (or q) is even.

A1: **States** q^2 is even (then q is even) and writes in the form $q = 2m$

dM1: Attempts $(2m)^2 = 4p^2 - 46$ and rearranges to a form where a contradiction can be deduced It is dependent on the previous method mark. e.g. $4m^2 = 4p^2 - 46 \Rightarrow m^2 = p^2 - \frac{46}{4}$ (which means m^2 and hence m cannot be an integer so there is a contradiction)

A1*: Full proof by contradiction. This must follow M1A1dM1

Look for

- a correct set up with words such as "assume there is" or "let there be" with "integers p and q"
- correct deductions
- a (minimal) conclusion

Question Number	Scheme	Marks
9 (a)	$\mathbf{a}=\mathbf{i}+\mathbf{j}-2\mathbf{k}\qquad \mathbf{b}=3\mathbf{i}-\mathbf{j}+6\mathbf{k}\qquad \mathbf{c}=-\mathbf{i}+3\mathbf{j}+6\mathbf{k}$ e.g. $\overrightarrow{BA}=\mathbf{a}-\mathbf{b}=-2\mathbf{i}+2\mathbf{j}-8\mathbf{k}$ (so $\overrightarrow{CD}=-2\mathbf{i}+2\mathbf{j}-8\mathbf{k}$) $\mathbf{d}=\mathbf{c}+\overrightarrow{CD}=-\mathbf{i}+3\mathbf{j}+6\mathbf{k}+-2\mathbf{i}+2\mathbf{j}-8\mathbf{k}=-3\mathbf{i}+5\mathbf{j}-2\mathbf{k}$	M1 dM1 A1 **(3)**
(b)	$\overrightarrow{BA}=\mathbf{a}-\mathbf{b}=-2\mathbf{i}+2\mathbf{j}-8\mathbf{k}$ and $\overrightarrow{BC}=\mathbf{c}-\mathbf{b}=-4\mathbf{i}+4\mathbf{j}$ $\cos\theta=\dfrac{\begin{pmatrix}-2\\2\\-8\end{pmatrix}.\begin{pmatrix}-4\\4\\0\end{pmatrix}}{\sqrt{(-2)^2+2^2+(-8)^2}\sqrt{(-4)^2+4^2}}=\dfrac{16}{\sqrt{72}\sqrt{32}}=\dfrac{1}{3}$ So angle is awrt 1.23 radians or awrt 70.5 degrees	M1 dM1 A1 A1 **(4)**
(c)	Area = $\sqrt{72}\sqrt{32}\times\sin"70.5"=45.3$ **or** $32\sqrt{2}$	M1A1 **(2)**
(d)	Area = $\dfrac{3}{2}\times"45.3"=67.9$ or $48\sqrt{2}$	M1 A1 **(2)**
		(11 marks)

(a) **Note that one correct component of $-3\mathbf{i}+5\mathbf{j}-2\mathbf{k}$ scores M1dM1A0 if no incorrect working seen**

M1: For attempting one of **b** – **a** or **a** – **b** or **c** – **b** or **b** – **c**. It must be correct for at least one of the components $\pm(-2\mathbf{i}+2\mathbf{j}-8\mathbf{k})$ or $\pm(-4\mathbf{i}+4\mathbf{j})$. Condone coordinate notation. May be implied by at least one correct component of $-3\mathbf{i}+5\mathbf{j}-2\mathbf{k}$

dM1: For attempting $\mathbf{d}=\mathbf{a}-\mathbf{b}+\mathbf{c}$ and proceeding to a position vector for *D*. It must be correct for at least one of the components. Condone coordinate notation. It is dependent on the previous method mark.

A1: $-3\mathbf{i}+5\mathbf{j}-2\mathbf{k}$ oe $\begin{pmatrix}-3\\5\\-2\end{pmatrix}$ Condone without brackets. Condone $(-3\mathbf{i},\ 5\mathbf{j},-2\mathbf{k})$

Correct answer no working scores all 3 marks. Condone coordinates.

Alt(a) Finding the mid point *E* of *AC* and then using $\mathbf{d}=\mathbf{b}+2\overrightarrow{BE}$ Must be a full method:

M1: Attempts $mp_{AC}=(0,2,2)$ and uses $\mathbf{d}=\mathbf{b}+2\overrightarrow{BE}$

M1: Attempts $(3,-1,6)+2\times(-3,3,-4)\Rightarrow....$

A1: $-3\mathbf{i}+5\mathbf{j}-2\mathbf{k}$ oe (see main scheme notes)