Question	Answer	Marks	Guidance
(a)	Using the correct process find the scalar product of direction vectors of l and **OA**	**M1**	$(1, 5, 6).(-1, 2, 3) = -1.1 + 5.2 + 6.3 = -1 + 10 + 18$
	Using the correct process for the moduli, divide the scalar product by the product of the moduli and find the inverse cosine of the result	**M1**	*Their* scalar product ÷ $[\sqrt{(1^2 + 5^2 + 6^2)}\sqrt{((-1)^2 + 2^2 + 3^2)}]$. Angle = $\cos^{-1}\dfrac{27}{\sqrt{62}\sqrt{14}}$.
	Obtain answer 23.6°.	**A1**	AWRT 23.6°. 23.5889°. Radians 0.412 scores A0 (0.4117…).
		3	
(b)	Taking a general point P on l, state **AP** (or **PA**) in component form, e.g. $(3 - \lambda, -5 + 2\lambda, -5 + 3\lambda)$	**B1**	Note: (4, 1, 0) or (4, 1, 1), for 4**i** + **k** is not MR, but M1 possible.
	Either equate scalar product of **AP** and direction vector of l to zero and solve for λ *or* use Pythagoras in a relevant triangle and solve for λ	**M1**	$(3 - \lambda, -5 + 2\lambda, -5 + 3\lambda).(-1, 2, 3) = 0$ $-3 \ -10 \ -15 + \lambda + 4\lambda + 9\lambda = 0$ or let **OQ** = (4, 0, 1) so **AQ** = (3, – 5, – 5), **QP** = $(-\lambda, 2\lambda, 3\lambda)$, **AP** = $(3 - \lambda, -5 + 2\lambda, -5 + 3\lambda)$ hence $3^2 + (-5)^2 + (-5)^2 =$ $(3 - \lambda)^2 + (-5 + 2\lambda)^2 + (-5 + 3\lambda)^2 + (-\lambda)^2 + (2\lambda)^2 + (3\lambda)^2$ Other alternative approaches are possible, e.g. minimise AP or AP^2, either by completing the square or by differentiating.
	Obtain $\lambda = 2$	**A1**	$\lambda = 2$
	State that the position vector **OP*** of the foot is 2**i** + 4**j** + 7**k**	**A1**	OE Condone coordinates.
		4	

Question	Answer	Marks	Guidance
(c)	Set up a correct method for finding the position vector of the reflection of A in l	**M1**	For all methods, allow a sign error in one component only: **OA′** = **OP*** + (**OP*** – **OA**) $their(2,4,7)+(their\,2,4,7-1,5,6)$ or **OA′** = **OP*** – (**OA** – **OP***) $their(2,4,7)-(1,5,6-their\,2,4,7)$ or **OA′** = **OA** + 2(**OP*** – **OA**) $\begin{pmatrix}1+2(their\,2-1)\\5+2(their\,4-5)\\6+2(their\,7-6)\end{pmatrix}$ or midpoint **OP*** = (**OA** + **OA′**)/2 with *their* λ value substituted. $\frac{1+x}{2}=their\,2\quad \frac{5+y}{2}=their\,4\quad \frac{6+z}{2}=their\,7$
	Obtain answer 3**i** + 3**j** + 8**k** or $3\left(\mathbf{i}+\mathbf{j}+\frac{8}{3}\right)$	**A1**	OE Condone coordinates $x=3, y=3, z=8$ A1. No method shown and correct answer 2/2.
		2	