Question	Scheme	Marks	AOs
5(a)	$\overrightarrow{OC}=0.8\mathbf{k}$, $\overrightarrow{OB}=3\mathbf{i}+0.8\mathbf{k}$ and $\overrightarrow{OD}=1.2\mathbf{j}+1.5\mathbf{k}$, or $\overrightarrow{CB}=3\mathbf{i}$, and $\overrightarrow{CD}=1.2\mathbf{j}+0.7\mathbf{k}$	B1	3.3
	So plane has equation $\mathbf{r}$ = their $\overrightarrow{OC}$ + their $\lambda\overrightarrow{CB}$ + their $\mu\overrightarrow{CD}$ (oe) OR $(a\mathbf{i}+b\mathbf{j}+c\mathbf{k}).(3\mathbf{i})=0$ and $(a\mathbf{i}+b\mathbf{j}+c\mathbf{k}).(1.2\mathbf{j}+0.7\mathbf{k})=0$ leading to a =..., b =... and c =... (may use vector product)	M1	1.1b
	Equation is $\mathbf{r}=0.8\mathbf{k}+\lambda(3\mathbf{i})+\mu(1.2\mathbf{j}+0.7\mathbf{k})$ OR normal is $\mathbf{n}=p(7\mathbf{j}-12\mathbf{k})$	A1	1.1b
	$x=3\lambda$, $y=1.2\mu$ and $z=0.8+0.7\mu \Rightarrow 70y-120z=-96$ OR $(0.8\mathbf{k}).(7\mathbf{j}-12\mathbf{k})=-9.6 \Rightarrow d=-9.6$	M1	1.1b
	Equation is $\mathbf{r}.(7\mathbf{j}-12\mathbf{k})=-9.6$ (or a multiple e.g. $\mathbf{r}.(70\mathbf{j}-120\mathbf{k})=-96$)	A1	2.5
		(5)	
(b)	Full attempt to find the minimum distance from the centre of the base rectangle to the plane – e.g. using the distance formula for closest point, or first finding the intersection point then finding the distance. Must have correct starting point (1.5,0.6,0).	M1	3.1b
	E.g. Minimum distance $=\dfrac{\lvert 0\times1.5+7\times0.6+(-12)\times0+9.6\rvert}{\sqrt{0^2+7^2+(-12)^2}}=\ldots$	M1	3.4
	= 0.993 m or 99.3 cm or 993 mm (to 3 s.f.) Accept awrt.	A1	1.1b
		(3)	
(c)	E.g. the boards will not have negligible thickness, which should be taken into account in the model, or wooden boards will bow and so not form planes.	B1	3.5b
		(1)	
		(9 marks)	

Notes:

(a) Accept use of column vectors throughout.

B1: Identifies three points on or two vectors in the plane that can be used to set up the model.

M1: Attempts a plane equation with their vectors OR attempts to find a normal vector using scalar (or cross) product.

A1: Correct plane equation OR correct normal vector (any multiple).

M1: Solves $x=3\lambda$, $y=1.2\mu$ and $z=0.8+0.7\mu$ to find equation x, y and z. OR Applies $\mathbf{r}.\mathbf{n}=d$ with a point on the line and their $\mathbf{n}$ to find d.

A1: Correct equation of plane in the correct form $\mathbf{r}.\mathbf{n}=d$, as shown or a multiple thereof.

(b)

M1: See scheme. Alternative methods can be used (e.g find p required for $\mathbf{r}=1.5\mathbf{i}+0.6\mathbf{j}+p(7\mathbf{j}-12\mathbf{k})$ to intersect the plane).

M1: Uses the model to attempt the minimum distance from any point to the plane, or an attempt to find the value of p for the point of intersection for the minimum distance.

A1: Correct answer awrt 993 mm or equivalent in m or cm.

(c) B1: Any reasonable limitation about the boards - e.g. those in the scheme.

5(a) **Alt**	Sets up equation of plane as $ax+by+c=d$	B1	3.3
	Identifies at least three points on the plane and substitutes in to the equation to form simultaneous equations. E.g. (3,0,0.8), (0,0,0.8), (0,1.2,1.5) and (3,1.2,1.5) give $3a+0.8c=d$ $0.8c=d$ $1.2b+1.5c=d$ $3a+1.2b+1.5c=d$ Note may use d = 1 with only 3 equations.	M1	1.1b
	Solves to find correct corresponding values. E.g. With d = 1, c = 1.25, a = 0 and $b = -\frac{35}{48}$ (so accept any appropriate multiples)	A1	1.1b
	Forms plane equation in correct form with their values. E.g. $-\frac{35}{48}y+\frac{5}{4}z=1(\Rightarrow 35y-60z=-48)\Rightarrow \mathbf{r}\cdot\mathbf{n}=d$	M1	1.1b
	Equation is $\mathbf{r}\cdot(35\mathbf{i}-60\mathbf{j})=-48$ (or any multiple)	A1	2.5
		(5)	

(a) Alt

B1: Sets up appropriate Cartesian plane equation for the model.

M1: Identifies at least three points on the plane and forms simultaneous equations using them in the general equation.

A1: Solves the equations to find correct values for the coefficients (may be a common multiple of the ones shown).

M1: Uses their coefficients in their Cartesian equation to form an equation for the plane in the correct form.

A1: Correct equation of plane in the correct form **r**.**n** = d, as shown or a multiple thereof.