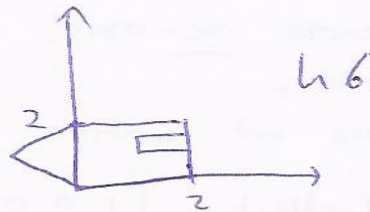
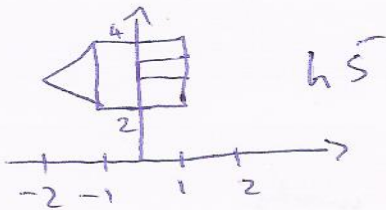
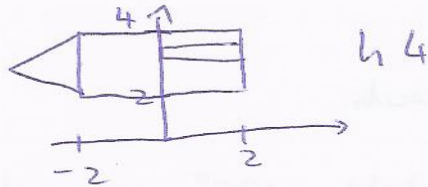
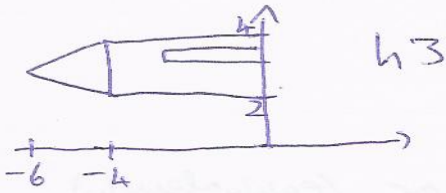
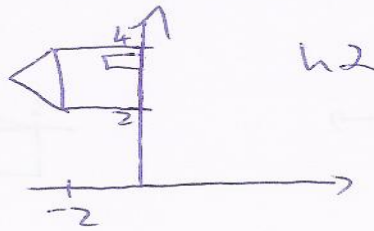
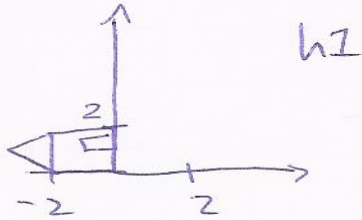


①



4 marks each
-2 for wrong amount or direction.

②

glLoadIdentity()

glRotate(90, 0, 0, 1)

glTranslate(2, 0, 0)

glTranslate(0, -1, 0)

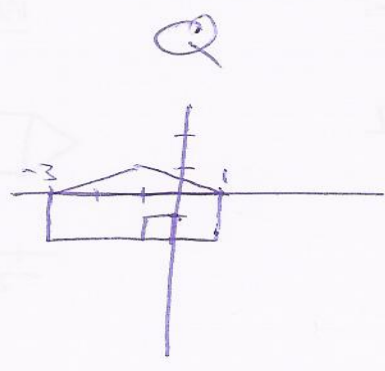
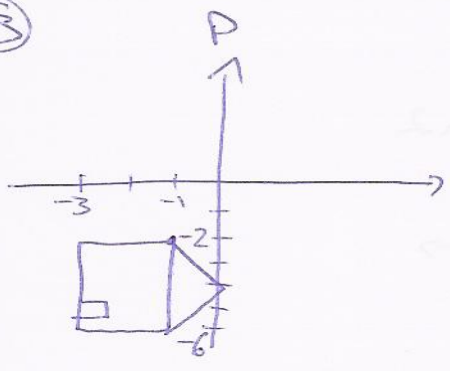
drawHouse()

} ≡

glTranslate(2, -1, 0)

or other correct combinations.

3



4 marks each.

4) Either rotate 180° around x-axis or (equivalently) reflect across x-axis.
Then shear.
Order does not matter.

$$A = \text{rotate/reflect} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

6 marks

$$B = \text{shear} = \begin{bmatrix} 1 & 0.5 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

6 marks

5) $A \circ P = -\frac{A_i}{2} - 3A_j$ 5 marks

$B \circ P = 2B_i - 2B_j$ 5 marks

6) T, F, F, F, F, T, F, T, F, F, T, F, F

⑦ See notes.

marks:

- 2 if correct but no/poor explanation.
- 5 close
- 7 proof missing, right track
- 9 no derivation

⑧ $L =$ screen / display / NDC / window

$M =$ camera / viewing / eye

⑨
$$\begin{bmatrix} 0 \\ 0 \\ -5 \end{bmatrix} + \begin{bmatrix} -1 \\ -1 \\ 1 \end{bmatrix} = \begin{bmatrix} -1 \\ -1 \\ -4 \end{bmatrix} = v^1$$

-1 for small errors.

⑩ Incorrect values ~~was~~ in ⑨ carried through into this question.

Let $P =$ perspective matrix

$b = -5$ $t = 5$ $t - b = 10$
 $d = -5$ $r = 5$ $r - d = 10$
 $n = 2$ $f = 10$ $f - n = 8$

$$= \begin{bmatrix} \frac{2n}{v-d} & 0 & \frac{r+t}{v-d} & 0 \\ 0 & \frac{2n}{t-b} & \frac{t+b}{t-b} & 0 \\ 0 & 0 & -\frac{(f+n)}{f-n} & -\frac{2fn}{f-n} \\ 0 & 0 & -1 & 0 \end{bmatrix}$$

$v^1 = Pv^1 = \begin{bmatrix} 4/10 & 0 & 0 & 0 \\ 0 & 4/10 & 0 & -2(20) \\ 0 & 0 & -12/8 & -20/8 \\ 0 & 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} -1 \\ -1 \\ -4 \\ 1 \end{bmatrix} = \begin{bmatrix} -0.4 \\ -0.4 \\ 1 \\ 4 \end{bmatrix}$

homogenise $\begin{bmatrix} -0.1 \\ -0.1 \\ 0.25 \\ 1 \end{bmatrix}$

- marks
- 1 for P
 - 1 for substituting
 - 2 for multiplying
 - 3 correct point from ⑨
 - 3 homogenising.