Books, watches, notes or cell phones are **not** allowed. The **only** calculators allowed are the Sharp EL-531**. You **must** show all your work, the correct answer is worth 1 mark the remaining marks are given for the work.

Question 1. *(5 marks)* Only using cofactor expansions evaluate

$$\begin{vmatrix} 3 & 0 & 4 & -6 \\ 2 & 7 & -1 & 1 \\ -4 & 1 & -6 & 8 \\ -2 & 0 & 4 & 4 \end{vmatrix} = \overset{0}{\overbrace{a_{12}C_{12}}} + a_{22}C_{22} + a_{32}C_{32} + \overset{0}{\overbrace{a_{42}C_{42}}}$$

$$= 7(-1)^{2+2} \begin{vmatrix} 3 & 4 & -6 \\ -4 & -6 & 8 \\ -2 & 4 & 4 \end{vmatrix} + 1(-1)^{2+3} \begin{vmatrix} 3 & 4 & -6 \\ 2 & -1 & 1 \\ -2 & 4 & 4 \end{vmatrix}$$

$$= 7 [a_{11}C_{11} + a_{12}C_{12} + a_{13}C_{13}] - [a_{11}C_{11} + a_{12}C_{12} + a_{13}C_{13}]$$

$$= 7 \left[3 \begin{vmatrix} -6 & 8 \\ 4 & 4 \end{vmatrix} - 4 \begin{vmatrix} -4 & 8 \\ -2 & 4 \end{vmatrix} + (-6) \begin{vmatrix} -4 & -6 \\ -2 & 4 \end{vmatrix} \right] - \left[3 \begin{vmatrix} -1 & 1 \\ 4 & 4 \end{vmatrix} - 4 \begin{vmatrix} 2 & 1 \\ -2 & 4 \end{vmatrix} + (-6) \begin{vmatrix} 2 & -1 \\ -2 & 4 \end{vmatrix} \right]$$

$$= 7 [3(-24-32) - 4(-16+16) - 6(-16-12)] - [3(-4-4) - 4(8+2) - 6(8-2)]$$

$$= 7 [3(-56) - 4(0) - 6(-28)] - [3(-8) - 4(10) - 6(6)]$$

$$= 7(0) - (-20)$$

$$= 100$$

Question 2. *(5 marks)* Evaluate $\underbrace{\begin{vmatrix} a-5g & -a+2d & -3g \\ b-5h & -b+2e & -3h \\ c-5i & -c+2f & -3i \end{vmatrix}}_{A}$, if we know $\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix} = -4$

$$|A| = |A^T|$$

$$= \begin{vmatrix} a-5g & b-5h & c-5i \\ -a+2d & -b+2e & -c+2f \\ -3g & -3h & -3i \end{vmatrix}$$

$$= \frac{-1}{3} R_3 \to R_3 \quad (-3) \begin{vmatrix} a-5g & b-5h & c-5i \\ -a+2d & -b+2e & -c+2f \\ g & h & i \end{vmatrix}$$

$$= \underset{5R_3 + R_1 \to R_1}{} -3 \begin{vmatrix} a & b & c \\ -a+2d & -b+2e & -c+2f \\ g & h & i \end{vmatrix}$$

$$= \underset{R_1 + R_2 \to R_2}{} -3 \begin{vmatrix} a & b & c \\ 2d & 2e & 2f \\ g & h & i \end{vmatrix}$$

$$= \underset{\frac{1}{2} R_2 \to R_2}{} (-3)(2) \begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix} = (-3)(2)(-4) = 24$$