No.	SOLUTION
A1	A
A2	A
A3	C
A4	D
A5	B
B1a	$LHS = \mathbf{A}^2 = \begin{bmatrix} 6 & -2 \\ -4 & 1 \end{bmatrix}\begin{bmatrix} 6 & -2 \\ -4 & 1 \end{bmatrix} = \begin{bmatrix} 44 & -14 \\ -28 & 9 \end{bmatrix}$ $RHS = 7\mathbf{A} + 2\,\mathbf{I} = 7\begin{bmatrix} 6 & -2 \\ -4 & 1 \end{bmatrix} + 2\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ $= \begin{bmatrix} 42 & -14 \\ -28 & 7 \end{bmatrix} + \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} 44 & -14 \\ -28 & 9 \end{bmatrix}$
B1b	$\mathbf{A}^2 = 7\mathbf{A} + 2\,\mathbf{I}$ $\mathbf{A}^{-1}\mathbf{A}^2 = 7\mathbf{A}^{-1}\mathbf{A} + 2\mathbf{A}^{-1}\mathbf{I}$ $\mathbf{A} = 7\mathbf{I} + 2\mathbf{A}^{-1}$ $\mathbf{A}^{-1} = \frac{1}{2}(\mathbf{A} - 7\mathbf{I})$
B2a	$\mathbf{C} = \mathbf{T_2 T_1} = \begin{bmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 2 & 0 & 0 \\ 0 & \frac{1}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & -\frac{1}{2} & 0 \\ 2 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
B2b	$\mathbf{S}' = \mathbf{CS} = \begin{bmatrix} 0 & -\frac{1}{2} & 0 \\ 2 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} -2 & 2 & 2 & -2 \\ 2 & 2 & -2 & -2 \\ 1 & 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} -1 & -1 & 1 & 1 \\ -4 & 4 & 4 & -4 \\ 1 & 1 & 1 & 1 \end{bmatrix}$
B2c	$\mathbf{C}^{-1} = \mathbf{T}_1^{-1}\mathbf{T}_2^{-1} = \begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & \frac{1}{2} & 0 \\ -2 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

No.	SOLUTION

B3a

$$1142 = 2(571) + 0$$
$$571 = 2(285) + 1$$
$$285 = 2(142) + 1$$
$$142 = 2(71) + 0$$
$$71 = 2(35) + 1 \qquad 0.125 \times 2 = 0.25 + 0$$
$$35 = 2(17) + 1 \qquad 0.25 \times 2 = 0.5 + 0$$
$$17 = 2(8) + 1 \qquad 0.5 \times 2 = 0 + 1$$
$$8 = 2(4) + 0$$
$$4 = 2(2) + 0$$
$$2 = 2(1) + 0$$
$$1 = 2(0) + 1$$

$$\therefore 1142.125 = 100\ 0111\ 0110.001_2$$
$$= 476.2_{16}$$

B3b

$$A1F.7B_{16} = 10 \times 16^2 + 1 \times 16^1 + 15 \times 16^0 + 7 \times 16^{-1} + 11 \times 16^{-2}$$
$$= 2591.4805$$

B4a

$$U = \{-5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8\}$$
$$R = \{-4, -2, 0, 2, 4, 6, 8\}$$
$$S = \{1, 2, 3, 4, 5, 6\}$$

B4b

$$R \cap S = \{2, 4, 6\}$$
$$R \cap \overline{S} = \{-4, -2, 0, 8\}$$
$$\overline{S} - R = \{-5, -3, -1, 7\}$$
$$\left| \overline{S} - R \right| = 4$$

B5

p	q	r	$\neg p$	$q \vee r$	$\neg p \vee (q \vee r)$	$p \wedge q$	$(p \wedge q) \Rightarrow r$	*ans*
F	F	F	T	F	T	F	T	T
F	F	T	T	T	T	F	T	T
F	T	F	T	T	T	F	T	T
F	T	T	T	T	T	F	T	T
T	F	F	F	F	F	F	T	T
T	F	T	F	T	T	F	T	T
T	T	F	F	T	T	T	F	T
T	T	T	F	T	T	T	T	T

Since all the entries are ‘true’, the proposition is a tautology.

No.	SOLUTION
B6a	$8! = 40320$
B6b	$5! = 120$
B6c	$8! - 6! = 40320 - 720 = 39600$
B6d	$3! \times 5! = 720$
B7a	$P(F) = \frac{37}{80} \quad (= 0.4625)$
B7b	$P(M \cap 4B) = \frac{26}{80} \quad \left(= \frac{13}{40} = 0.325\right)$
B7c	$P(M \cup 4B) = \frac{58}{80} \quad \left(= \frac{29}{40} = 0.725\right)$
B7d	$P(4A \mid F) = \frac{22}{37} \quad (= 0.\overline{594})$

C1a	$p=F, q=T, r=F, s=T$ Since $(\neg p\wedge q)\Rightarrow(r\vee\neg s)$ is false, $(\neg p\wedge q)$ is true and $(r\vee\neg s)$ is false. For $(\neg p\wedge q)$ to be true, p must be false and q must be true. For $(r\vee\neg s)$ to be false, r must be false and s must be true.
C1b	$\overline{a}(a+b)+(a+c)(a+\overline{b})$ $=\overline{a}\,b+a+\overline{b}\,c$ $=a+b+\overline{b}\,c$ $=a+b+c$
C1c (i)	(see table below)
C1c (ii)	$f(a,b,c)=\overline{a}\,\overline{b}\,c+\overline{a}\,b\,\overline{c}+a\,\overline{b}\,\overline{c}+a\,b\,c$
C2a	$\left({}^{5}C_{4}\times{}^{13}C_{6}\right)+\left({}^{5}C_{5}\times{}^{13}C_{5}\right)=9867$
C2b	$\left({}^{5}C_{3}\times{}^{7}C_{7}\right)+\left({}^{5}C_{4}\times{}^{7}C_{6}\right)+\left({}^{5}C_{5}\times{}^{7}C_{5}\right)=66$ **or** ${}^{12}C_{10}=66$
C2c	Without restriction = ${}^{18}C_{10}=43758$ Only squash and tennis = $\left({}^{5}C_{4}\times{}^{6}C_{6}\right)+\left({}^{5}C_{5}\times{}^{6}C_{5}\right)=11$ **or** ${}^{11}C_{10}=11$ Only tennis and badminton = $\left({}^{6}C_{3}\times{}^{7}C_{7}\right)+\left({}^{6}C_{4}\times{}^{7}C_{6}\right)+\left({}^{6}C_{5}\times{}^{7}C_{5}\right)+\left({}^{6}C_{6}\times{}^{7}C_{4}\right)=286$ **or** ${}^{13}C_{10}=286$ Only squash and badminton = 66 (from part b) At least 1 player from each sport = $43758-11-286-66=43395$

C1c (i):

a	b	c	$f(a,b,c)$
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

C3a	$\mathbf{R}_\alpha = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} \cos(-\alpha) & -\sin(-\alpha) \\ \sin(-\alpha) & \cos(-\alpha) \end{bmatrix}$ $= \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$ $= \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix} \begin{bmatrix} \cos\alpha & \sin\alpha \\ \sin\alpha & -\cos\alpha \end{bmatrix}$ $= \begin{bmatrix} \cos^2\alpha - \sin^2\alpha & 2\sin\alpha\cos\alpha \\ 2\sin\alpha\cos\alpha & \sin^2\alpha - \cos^2\alpha \end{bmatrix}$ $= \begin{bmatrix} \cos 2\alpha & \sin 2\alpha \\ \sin 2\alpha & -\cos 2\alpha \end{bmatrix}$
C3b	$\mathbf{C} = \mathbf{R}_\beta \mathbf{R}_\alpha$ $= \begin{bmatrix} \cos 2\beta & \sin 2\beta \\ \sin 2\beta & -\cos 2\beta \end{bmatrix} \begin{bmatrix} \cos 2\alpha & \sin 2\alpha \\ \sin 2\alpha & -\cos 2\alpha \end{bmatrix}$ $= \begin{bmatrix} \cos 2\beta \cos 2\alpha + \sin 2\beta \sin 2\alpha & \cos 2\beta \sin 2\alpha - \sin 2\beta \cos 2\alpha \\ \sin 2\beta \cos 2\alpha - \cos 2\beta \sin 2\alpha & \sin 2\beta \sin 2\alpha + \cos 2\beta \cos 2\alpha \end{bmatrix}$ $= \begin{bmatrix} \cos(2\beta - 2\alpha) & -\sin(2\beta - 2\alpha) \\ \sin(2\beta - 2\alpha) & \cos(2\beta - 2\alpha) \end{bmatrix}$
C3c	$\alpha = 45°, \quad \beta = 135°$ $\theta = 2\beta - 2\alpha = 180°$