Question Number	Scheme	Marks
4 (a)	$2k + k + k + 5k = 1$	M1
	$k = \frac{1}{9}$ *	A1cso (2)
(b)	$P(1 \leqslant X < 4) = \frac{2}{9}$	B1 (1)
(c)	$E(X) = (1\times)\frac{1}{9} + 2\times\frac{1}{9} + 4\times\frac{5}{9}$ or $E(X) = (1\times)k + 2\times k + 4\times 5k [= 23k]$	M1
	$= \frac{23}{9}$ oe	A1 (2)
(d)	$E(X^2) = 1\times\frac{1}{9} + 2^2\times\frac{1}{9} + 4^2\times\frac{5}{9}$ or $E(X^2) = 1\times k + 2^2\times k + 4^2\times 5k [= 85k]$	M1
	$= \frac{85}{9}$ oe	A1 (2)
(e)	$\text{Var}(X) = '\frac{85}{9}' - \left('\frac{23}{9}'\right)^2$ [= 2.91…]	M1
	$\text{Var}(3X+1) = 9\times\left(\frac{85}{9} - \left(\frac{23}{9}\right)^2\right)$	M1
	$= \frac{236}{9}$ oe	A1 (3)
	Notes	Total 10

Question Number	Scheme	Marks
2.(a)	[E(X) =] $(-2\times 0.15) + (-1\times a) + 0 + (1\times a) + (3\times 0.4)$ or $-0.3 - a + a + 1.2$	M1
	$= \underline{\mathbf{0.9}}$	A1 (2)
(b)	[E(X^2) =] $\{(-2)^2\times 0.15\} + \{(-1)^2\times a\} + \{1^2\times a\} + \{3^2\times 0.4\}$	M1
	or $0.6 + 2a + 3.6$	
	So $4.2 + 2a = 4.54$	dM1
	$a = \underline{\mathbf{0.17}}$	A1
	Use of sum of probabilities = 1 e.g. $0.15 + $ "0.34" $+ 0.4 + b = 1$	M1
	$b = \underline{\mathbf{0.11}}$	A1 (5)
(c)	[Var(X) =] $4.54 - (\text{their } 0.9)^2$ [= 3.73]	M1
	$\text{Var}(Y) = (-2)^2\,\text{Var}(X)$	M1
	$= \underline{\mathbf{14.92}}$ (accept 14.9)	A1 (3)
		[10 marks]

Question Number	Scheme	Marks
5. (a)	$[-2\times1000+20000]=(£)18000$	B1 (1)
(b)	$S_{wy}=2490-\frac{81\times405}{9}$ or $2490-3645$ $[=-1155]$	B1
	$r=\frac{"-1155"}{\sqrt{660\times2500}}$ or $\frac{"-1155"}{\sqrt{1650000}}=-0.899$ (*)	M1 A1cso (3)
(c)	-0.899 (or "same"); as (linear) coding does not have any effect on correlation	B1 (1)
(d)	$y=60.75-1.75\frac{(x-20000)}{1000}$	M1
	$y=95.75-0.00175x$	A1A1 (3)
(e)	$y=95.75-0.00175(21000)$ or $y=60.75-1.75(1)$	M1
	$y=59$ awrt **59**	A1 (2)
(f)	**Data:** $x=(£)18000$ to $x=(£)45000$ or **Franca:** $w=5$ to $w=20$	M1
	As this is interpolation, the estimates are reliable.	A1 (2)
		[12 marks]

Question Number	Scheme	Marks
3.(a)	(Discrete) **Uniform**	B1 (1)
(b)	$P(X=4)=\frac{1}{5}$ oe	B1 (1)
(c)	$F(3)=\frac{3}{5}$ oe	B1 (1)
(d)	$P(3X-3>X+4)=P(X>3.5)$ $=\frac{2}{5}$ oe	M1 A1 (2)
(e)	$E(X)=$ **3**	B1 (1)
(f)	$E(X^2)=\frac{1}{5}\left(1^2+2^2+3^2+4^2+5^2\right)$ = **11**	M1 A1 (2)
(g)	Var $(X)=11-3^2$ or $\frac{(5+1)(5-1)}{12}$ = **2**	M1 A1 (2)
(h)	$11.4=aE(X)-3$ **or** $11.4=3a-3$ $a=4.8$ Var $(4.8X-3)=$ '4.8'$^2\times$ '2' $=46.08$ awrt **46.1**	M1 A1 M1 A1 (4)
		Total 14

Question	Scheme	Marks
5. (a)	$-2a+(0)+2a+4c=0.8$ or $4c=0.8$	M1
	$\underline{\boldsymbol{c=0.2}}$	A1
		(2)
(b)	$4a+(0)+4a+16c=5$ or $8a+16c=5$	M1
	$8a+3.2=5$ so $\underline{\boldsymbol{a=0.225}}$ or $\underline{\frac{9}{40}}$	A1
	$2a+b+c=1$ so $b=1-"0.2"-2\times"0.225"$	M1
	$\underline{\boldsymbol{b=0.35}}$ or $\underline{\frac{7}{20}}$	A1ft
		(4)
(c)	$\text{Var}(X)=5-0.8^2$, $=\underline{\boldsymbol{4.36}}$	M1A1
		(2)
(d)	$[5-3\text{E}(X)=5-3\times0.8]$ $=\underline{\boldsymbol{2.6}}$	B1
		(1)
(e)	$3^2\,\text{Var}(X)=9\times4.36$, or $[\text{E}(Y^2)-(\text{E}(Y))^2]=46-2.6^2$ $=\underline{\boldsymbol{39.24}}$ awrt $\underline{\boldsymbol{39.2}}$	M1, A1
		(2)
(f)	$Y\geq0\Rightarrow 5-3X\geq0\Rightarrow 5\geq3X$	M1
	$X\leq1\frac{2}{3}$	A1
	$[\text{P}(Y\geq0)=\text{P}(X\leq0)=]$ $\text{P}(X=-2)+\text{P}(X=0)$ $\underline{\text{or}}$ $a+b$	M1
	$=\underline{\boldsymbol{0.575}}$ or $\underline{\frac{23}{40}}$	A1ft
		(4)
		[15]

Question Number	Scheme	Marks
6. (a)	$[\text{E}(A)=]\ 1\times0.4+4\times0.2+5\times0.25+7\times0.15$	M1
	$=\underline{\boldsymbol{3.5}}$ (*)	A1cso
		(2)
(b)	$[\text{E}(A^2)=]1\times0.4+4^2\times0.2+5^2\times0.25+7^2\times0.15$ [= 17.2]	M1
	$\text{Var}(A)=\text{E}(A^2)-[\text{E}(A)]^2=17.2-3.5^2$	M1
	$=\underline{\boldsymbol{4.95}}$	A1
		(3)
(c)	(Discrete) uniform (distribution)	B1
		(1)
(d)	By symmetry $k=6$	B1
		(1)
(e)	[Sam has $Z=\frac{3.5-4}{3}=-\frac{1}{6}$ and] Tim needs $\frac{3.5-A}{4}<-\frac{1}{6}$ so $A>4.166..$	M1
	So prob $=0.25+0.15=\underline{\boldsymbol{0.4}}$	A1
		(2)
(f)	Need largest possible $\mu=7$ and smallest possible $\sigma=1$	B1, B1
	$\text{P}(X>3.5)$ is then $\text{P}\left(Z>\frac{3.5-7}{1}\right)=\text{P}(Z>-3.5)$	M1
	$=\underline{\boldsymbol{0.9998}}$ (tables) or 0.999767…(calc)	A1
		(4)
(g)	[Need $A=7$ and $B=1$ (or ft from (f)) so] $\text{P}(A=7)\times\text{P}(B=1)$ $\underline{\text{or}}$ "0.15"$\times0.25$	M1
	$=\underline{\boldsymbol{0.0375}}$	A1cso
		(2)
		[15]

Question	Scheme	Marks
6. (a)	For sight of $0.6^2 \times 0.4$ (o.e.)	B1cso (1)
(b)(i)	$P(X=1) = \mathbf{0.4}$	B1
(ii)	$P(X=4) = 1 - \text{"0.4"} - 0.24 - 0.144$ or $0.6^3 \times 0.4 + 0.6^4$ or 0.6^3 $= \mathbf{0.216}$	M1 A1 (3)
(c)	$[E(X) =] 1\times0.4 + 2\times0.24 + 3\times0.144 + 4\times0.216$, $= 2.176$ awrt **2.18**	M1, A1 (2)
(d)	$[E(X^2) =] 1^2\times0.4 + 2^2\times0.24 + 3^2\times0.144 + 4^2\times0.216$ $[= 6.112]$ $\text{Var}(X) = \text{"6.112"} - 2.176\text{"}^2$ $= 1.377024$ awrt **1.38**	M1 M1 A1 (3)
(e)	stop after 1 head so 1 is the max value and can get no heads for 4 tails $P(H = \mathbf{0}) = \mathbf{0.1296}$ and $P(H = \mathbf{1}) = \mathbf{0.8704}$	B1 B1 (2)
(f)(i)	$[P(\{X=3\} \cap \{H=0\}) =] = \mathbf{0}$	B1
(ii)	$[P(\{X=4\} \cap \{H=0\}) =]$ $P(H=0) = 0.6^4 = \mathbf{0.1296}$ or $\frac{81}{625}$	B1ft (2)
(g)	$[s]$: 2, 3, 4, 5 $[P(S=s)]$: 0.4, 0.24, 0.2736, 0.0864	B1ft B1 B1ft B1 (4) **(17 marks)**

Question Number	Scheme	Marks
7 (a)	$\frac{k+4}{8} = 1 \quad [k = 4^*]$	B1* (1)
(b)	x: 1, 2, 3, 4 $P(X=x)$: $\frac{1}{13}$, $\frac{7}{26} - \frac{1}{13} = \frac{5}{26}$, $\frac{15}{26} - \frac{7}{26} = \frac{4}{13}$, $1 - \frac{15}{26} = \frac{11}{26}$	M1 M1 A1 (3)
(c)	4	B1ft (1)
(d)	$E(X) = 1\times\frac{1}{13} + 2\times'\frac{5}{26}' + 3\times'\frac{4}{13}' + 4\times'\frac{11}{26}'\left[= \frac{40}{13}\right]$	M1
	$E(X^2) = 1^2\times\frac{1}{13} + 2^2\times'\frac{5}{26}' + 3^2\times'\frac{4}{13}' + 4^2\times'\frac{11}{26}'\left[= \frac{135}{13}\right]$	M1
	$\text{Var}(X) = '\frac{135}{13}' - '\left(\frac{40}{13}\right)^2'\left[= \frac{155}{169}\right]$	M1
	$\text{Var}(13X-6) = 13^2\times'\frac{155}{169}'$	M1
	$= 155$	A1 (5)

Y	7	20	33	46
$P(Y=y)$	$\frac{1}{13}$	$\frac{5}{26}$	$\frac{4}{13}$	$\frac{11}{26}$

$E(Y) = 7\times'\frac{1}{13}' + 20\times'\frac{5}{26}' + 33\times'\frac{4}{13}' + 46\times'\frac{11}{26}'\left[= 34\right]$

$E(Y^2) = 7^2\times'\frac{1}{13}' + 20^2\times'\frac{5}{26}' + 33^2\times'\frac{4}{13}' + 46^2\times'\frac{11}{26}'$ $[= 1311]$

$\text{Var}(13X-6) = '1311' - '34'^2$

Notes	Total 10

Question Number	Scheme	Marks
4 (a)	(Discrete) uniform (distribution)	B1 (1)
(b)(i)	[By symmetry] E(X) = **13**	B1 (1)
(ii)	$\frac{10^2+12^2+14^2+16^2}{4}-13^2$ or $\frac{696}{4}-169$ or $174-169$	M1
	= **5**	A1 (2)
(c)(i)	$E(Y)=\frac{1}{30}(1\times4+2\times9+3\times6+4\times5+5\times6)$; $=\frac{90}{30}$ = **3**	M1; A1 (2)
(ii)	$E(Y^2)=\frac{1}{30}(1^2\times4+2^2\times9+3^2\times6+4^2\times5+5^2\times6)=\left[\frac{324}{30}\text{ or }10.8\right]$	M1
	Var(Y) = "10.8" – "[3]"^{2}; = **1.8**	M1; A1 (3)
(d)	E(W) = E(Y) $\Rightarrow$ aE(X) + b [= E(W) or E(Y) or "3"]; i.e. "13"a + b = "3"	M1; A1ft
	Var(W) = Var(Y) $\Rightarrow$ $a^2\times$"5" = "1.8"; so $a = \frac{3}{5}$ or **0.6**	M1; A1
	b = **– 4.8**	A1 (5)
(e)	Values of w are: 10×"0.6"–"4.8" = 1.2 or 2.4 or 3.6 or 4.8 i.e. all non integers	M1
	[So no cases are possible when $W = Y$ so P($W = Y$)] = **0**	A1 (2)
		[16 marks]