5(a)	$\left[\mathrm{E}\left(R^2\right)=\right]2^2\times0.25+3^2\times0.3+4^2\times0.15+5^2\times0.1+6^2\times0.2$ $(=15.8^*)$	B1cso*
		(1)
(b)	$\left[\mathrm{sd}\ (R)=\right]\sqrt{15.8-3.7^2}$	M1
	$=\sqrt{2.11}$	
	Standard deviation = 1.4525.... awrt 1.45	A1
		(2)
(c)	$d=1$	B1
		(1)
(d)	$0.1+0.2+0.1+a+b=1$ oe	M1
	$2\times0.1+3\times0.2+4\times0.1+5a+6b=4.55$ oe	M1
	$5(0.6-b)+6b=3.35$ **or** $5a+6(0.6-a)=3.35\Rightarrow a=0.25$ **or** $b=0.35$	M1
	$c=0.4+"0.25"$ **or** $c=1-"0.35"$	M1
	$c=0.65$ oe	A1
		(5)
(e)	$0.9\times0.75\times0.1$	M1
	$=0.0675$	A1
		(2)
(f)	For identifying that if Jessie scores 2, Pabel has no spin oe may be implied	M1
	$[0.10\times0+]0.2\times0.3+0.1\times0.15+"0.25"\times0.1+"0.35"\times0.2$	M1
	$=0.17$	A1
		(3)

Question	Scheme	Marks
3 (a)	$\mathrm{E}(X)=2a+3\times0.4+4(0.6-a)\ \left[=3.6-2a\right]$	M1 A1
		(2)
(b)	$0<a<0.6$ oe	B1
	$2\times0.6+3\times0.4[=2.4]$ or $3.6-2\times0.6[=2.4]$ **and** $3\times0.4+4\times0.6[=3.6]$ or $3.6-2\times0[=3.6]$ **Alternative** $0>-2a>-1.2$ $3.6>3.6-2a>2.4$	M1
	$2.4<\mathrm{E}(X)<3.6$	A1
		(3)
(c)	$\mathrm{Var}(X)=\mathrm{E}(X^2)-\mathrm{E}(X)^2$	
	$\left[\mathrm{E}(X^2)=\right]4a+3.6.+9.6-16a[=13.2-12a]$	M1 A1
	$\mathrm{Var}(X)='(13.2-12a)'-('3.6-2a')^2$	M1
	$-4a^2+2.4a-0.32=0$	A1
	$a=\dfrac{-'2.4'\pm\sqrt{'2.4'^2-4\times'-4'\times'-0.32'}}{2\times'-4'}$	M1
	$a=\dfrac{1}{5}\quad a=\dfrac{2}{5}$	A1
		(6)
	Notes	**Total 11**

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

Question Number	Scheme	Marks
4. (a)	$E(X) = -4a + (-3b) + a + 2b + 5\times0.2 [= -3a - b + 1]$	B1 (1)
(b)(i)	$E(X) = 0$	B1
(ii)	$a + b + a + b + 0.2 = 1$ $-3a - b + 1 = 0$ Solving simultaneously to give $\underline{a = 0.3}$ $\underline{b = 0.1}$	B1 M1 A1 A1 (5)
(c)	$\text{Var}(1 - 3X) = 9\text{Var}(X)$ $E(X^2) = (-4)^2a + (-3)^2b + a + (2^2)b + 25\times0.2 [= 11.4]$ $\text{Var}(1 - 3X) = 102.6$ awrt $\underline{103}$	M1 M1 A1 (3)
(d)(i)	$[P(Y < 0) = P(1 - X < 0) =]$ $P(X > 1) = b + 0.2 = 0.3$	M1 A1ft
(ii)	$\left[P(Y < k) = P(1 - X < k)\right] =$ $P(X > (1 - k)) = 0.2 \Rightarrow 1 - k = 2$ $\underline{k = -1}$	M1 A1 (4)
		[13 marks]

Question Number	Scheme	Marks
4. (a)	$[\mathrm{E}(X)=]5\times0.13+6\times0.21+7\times0.29+8\times0.37,$ $= \underline{\mathbf{6.9}}$	**M1, A1** **(2)**
(b)	$[\mathrm{E}(X^2)=]5^2\times0.13+6^2\times0.21+7^2\times0.29+8^2\times0.37[=48.7]$ $= \underline{\mathbf{1.09}}$ $\mathrm{Var}(X)=48.7-'6.9'^2,$	**M1** **M1, A1** **(3)**
(c)	$\mathrm{Var}(3-2X)=(-2)^2\mathrm{Var}(X),$ $= \underline{\mathbf{4.36}}$	**M1, A1** **(2)**
(d)	$[\mathrm{E}(Y)] = \underline{\mathbf{6.5}}$ or $\frac{13}{2}$ (o.e.)	**B1** **(1)**
(e)	$\mathrm{P}(X=Y)=\frac{1}{4}\times0.13+\frac{1}{4}\times0.21+\frac{1}{4}\times0.29+\frac{1}{4}\times0.37\ ,=\frac{1}{4}$ (oe)	**M1, A1** **(2)**
(f)	$\mathrm{P}(X>Y)=\mathrm{P}(X=6\cap Y<6)+\mathrm{P}(X=7\cap Y<7)+\mathrm{P}(X=8\cap Y<8)$ $=0.21\times0.25+0.29\times0.50+0.37\times0.75$ $= \underline{\mathbf{0.475}}$	**M1** **M1** **A1** **(3)**
		[13 marks]

Question Number	Scheme	Marks
4 (a)	$\mathrm{E}\left(\frac{1}{X}\right)=1\times\frac{1}{10}+\frac{1}{2}\times\frac{1}{5}+\frac{1}{3}\times\frac{3}{10}+\frac{1}{4}\times\frac{2}{5}=\frac{2}{5}*$	B1* (1)
(b)	$\mathrm{E}\left(\left(\frac{1}{X}\right)^2\right)=1^2\times\frac{1}{10}+\left(\frac{1}{2}\right)^2\times\frac{1}{5}+\left(\frac{1}{3}\right)^2\times\frac{3}{10}+\left(\frac{1}{4}\right)^2\times\frac{2}{5}\left[=\frac{5}{24}\right]$	M1
	$\mathrm{Var}\left(\frac{1}{X}\right)=\frac{5}{24}-\left(\frac{2}{5}\right)^2=\frac{29}{600}$	M1 A1 (3)
(c) (i)	$[\mathrm{E}(Y)=]12$	B1
(ii)	$[\mathrm{Var}(Y)=]30^2\,'\mathrm{Var}\left(\frac{1}{X}\right)'=\frac{87}{2}$ or If y : 30 15 10 7.5 then $[\mathrm{Var}(Y)=]\frac{375}{2}-12^2=\frac{87}{2}$	M1 A1 (3)
(d)	$[Y<20\Rightarrow]\frac{30}{X}<20\Rightarrow X>1.5$ or y : 30 15 10 7.5	M1
	$\mathrm{P}(Y<20)=\mathrm{P}(X>1.5)=\frac{9}{10}$	A1
	$[\mathrm{P}(X<3\,\vert\,Y<20)=]\frac{\mathrm{P}(X=2)}{\mathrm{P}(X>1.5)}=\frac{\frac{1}{5}}{\left(\frac{9}{10}\right),}=\frac{2}{9}$ or $[\mathrm{P}(X<3\,\vert\,Y<20)=]\frac{\mathrm{P}(Y=15)}{\mathrm{P}(Y<20)}=\frac{\frac{1}{5}}{\left(\frac{9}{10}\right),}=\frac{2}{9}$	dM1 A1 A1 (5)
	Notes	**Total 12**

Question Number	Scheme	Marks
5. (a)	$\{E(X) = \}\ -2a - b + 0 \times c + b + 4a$ or $2a$	M1
	$\{2a = 0.5$ so $\}$ $\underline{\boldsymbol{a = 0.25}}$	A1
		(2)
(b)	$\{E(X^2) = \}(-2)^2 \times a + (-1)^2 \times b + 0 + 1^2 \times b + 4^2 \times a$ or $20a + 2b$ (o.e.)	M1
	$\{\text{Var}(X) = \}"20a + 2b" - 0.5^2$	M1
	$20a + 2b - 0.25 = 5.01$ (o.e.) e.g. $"4.75" + 2b = 5.01$	A1
	$\{2b = 0.26$ so $\}$ $\underline{\boldsymbol{b = 0.13}}$	A1
	{Use of sum of probs = 1 to calculate a 2nd value} $\underline{\boldsymbol{c = 0.24}}$	A1ft
		(5)
(c)(i)	$\{E(Y) = 5 - 8 \times 0.5\ \}$ = $\underline{\mathbf{1}}$	B1
(ii)	$\{\text{Var}(Y) = \}\ (-8)^2 \times 5.01$	M1
	$= 320.64$ awrt $\underline{\mathbf{321}}$	A1
		(3)
(d)	$4X^2 > 5 - 8X$	M1
	$(2X - 1)(2X + 5) > 0 \Rightarrow X > 0.5$	M1A1
	So need $X = 1$ or 4 or probability of $a + b$	M1
	$= \underline{\mathbf{0.38}}$	A1
		(5)
		[15 marks]