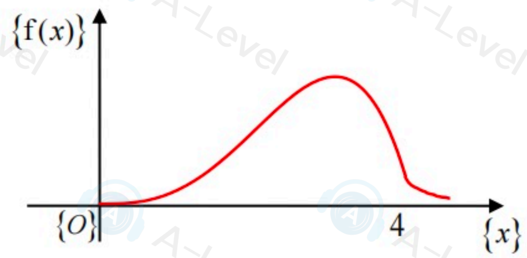
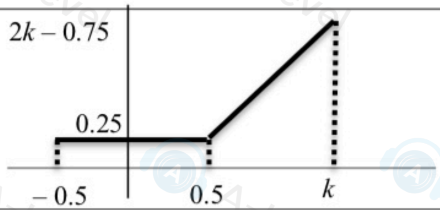
Question Number	Scheme	Marks
4. (a)	$\{E(X)=\}\int_0^2 x\frac{3}{64}x^2(4-x)\,dx$	M1
	$=\frac{3}{64}\left[x^4-\frac{x^5}{5}\right]_0^4$	A1
	$=2.4$	A1
	So, mean number of hours is **2400**	A1ft
		[4]
(b)	$\{E(X^2)=\}\int_0^2 x^2\frac{3}{64}x^2(4-x)\,dx$	M1
	$=\frac{3}{64}\left[\frac{4x^5}{5}-\frac{x^6}{6}\right]_0^4\ \{=6.4\}$	A1
	$\sigma_x=\sqrt{6.4-(2.4)^2}=0.8$ **0.8**	dM1 A1
		[4]
(c)	Some components may last longer than 4000 hours/ X could be greater than 4	B1
		[1]
(d)	Eg.  Sketch of a pdf with $x\geq 0$ and right end going beyond 4. Must be asymptotic or touch the x-axis beyond 4. Ignore labels of $f(x)$, O and x.	B1
		[1]
		10

Question Number	Scheme	Marks
2 (a)		M1 A1
		(2)
(b)	Area = $\frac{1}{4}+\frac{1}{2}\left(\frac{1}{4}+2k-\frac{3}{4}\right)\left(k-\frac{1}{2}\right)=1$ **or** $\frac{1}{4}\left(k+\frac{1}{2}\right)+\frac{1}{2}(2k-1)\left(k-\frac{1}{2}\right)=1$ **or** $\frac{1}{4}+\left[\left(k^2-\frac{3}{4}k\right)-\left(\frac{1}{2}^2-\frac{3}{8}\right)\right]=1$	M1
	$8k^2-6k-5=0$ or $k^2-\frac{3}{4}k-\frac{5}{8}=0$ oe	A1
	$(4k-5)(2k+1)=0$ or $k=\dfrac{\frac{3}{4}\pm\sqrt{\left(-\frac{3}{4}\right)^2+4\times\left(\frac{5}{8}\right)}}{2}$ oe	M1
	$k = 1.25$*	A1 *
		(4)
(c)	$\left[\int_{-0.5}^{0.5}\frac{1}{4}x\,dx\right]+\int_{0.5}^{1.25}2x^2-\frac{3}{4}x\,dx=[0]+\left[\frac{2x^3}{3}-\frac{3}{8}x^2\right]_{0.5}^{1.25}$	M1A1
	$=\left(\frac{2\times1.25^3}{3}-\frac{3}{8}\times1.25^2\right)-\left(\frac{2\times0.5^3}{3}-\frac{3}{8}\times0.5^2\right)$	dM1
	$=\frac{93}{128}$ awrt 0.727	A1
		(4)
(d)	$[Q_1=]\ 0.5$	B1
	$Q_3^2-\frac{3}{4}Q_3+0.125=0.5$ or $Q_3^2-\frac{3}{4}Q_3-0.375=0$ oe	M1
	$Q_3=\dfrac{\frac{3}{4}\pm\sqrt{\left(-\frac{3}{4}\right)^2+4\times\left(\frac{1}{8}\right)}}{2}$	M1
	IQR ="1.093…" – 0.5	M1
	= 0.593… awrt 0.59	A1
		(5)
	Notes	**Total 15**

Question Number	Scheme	Marks
5(a)	$\int_{-1}^{2} k(x^2+a)\mathrm{d}x + \int_{2}^{3} 3k\ \mathrm{d}x = 1$	M1
	$\left[k\left(\frac{x^3}{3}+ax\right)\right]_{-1}^{2} + \left[3kx\right]_2^3 = 1$	dM1
	$k\left(\frac{8}{3}+2a+\frac{1}{3}+a\right)+9k-6k=1$	A1
	$6k+3ak=1$	
	$\int_{-1}^{2} k(x^3+ax)\mathrm{d}x + \int_{2}^{3} 3kx\ \mathrm{d}x \left[=\frac{17}{12}\right]$	M1
	$\left[k\left(\frac{x^4}{4}+\frac{ax^2}{2}\right)\right]_{-1}^{2} + \left[\frac{3kx^2}{2}\right]_2^3 = \frac{17}{12}$	dM1
	$k\left(4+2a-\frac{1}{4}-\frac{a}{2}\right)+\frac{27k}{2}-6k=\frac{17}{12}$	A1
	$\frac{45k}{4}+\frac{3ak}{2}=\frac{17}{12}$	
	$135k+18ak=17$	
	$99k = 11$	ddM1
	$a=1, k=\frac{1}{9}$	A1
		(8)
(b)	2	B1
		(1)

Question	Scheme	Marks
	Ignore any incorrect comparison eg 0.0465 < 0.025 if all previous marks have been awarded.	

Question	Scheme	Marks
4(a)	$\mathrm{E}(X^2)=\int_1^3 \frac{1}{15}(3x^4-x^5)\,\mathrm{d}x+\int_3^5 \frac{3}{10}(x^3-3x^2)\,\mathrm{d}x$	M1
	$=\left[\frac{1}{15}\left(\frac{3x^5}{5}-\frac{x^6}{6}\right)\right]_1^3+\left[\frac{3}{10}\left(\frac{x^4}{4}-x^3\right)\right]_3^5$	M1 A1
	$=\frac{2923}{225}=12.99\ldots$ awrt **<u>13.0</u>**	A1
		(4)
(b)	$\int_1^x \frac{1}{15}(3t^2-t^3)\,\mathrm{d}t$ or $\int \frac{1}{15}(3x^2-x^3)\,\mathrm{d}x$ with $+c$ and $\mathrm{F}(1)=0$	M1
	$\int_1^3 \frac{1}{15}(3t^2-t^3)\,\mathrm{d}t+\int_3^x \frac{3}{10}(t-3)\,\mathrm{d}t$ or $\int \frac{3}{10}(x-3)\,\mathrm{d}x$ with $+d$ and $\mathrm{F}(5)=1$	M1
	$[\mathrm{F}(x)=]\begin{cases}0 & x<1\\ \frac{1}{15}x^3-\frac{1}{60}x^4-\frac{1}{20} & 1\le x<3\\ \frac{3}{20}x^2-\frac{9}{10}x+\frac{7}{4} \text{ or } \frac{3}{20}(x-3)^2+0.4 & 3\le x\le 5\\ 1 & x>5\end{cases}$	B1 A1 A1
		(5)
(c)	$\mathrm{P}(2<X<4)=\mathrm{F}(4)-\mathrm{F}(2)$ or $\int_2^3 \frac{1}{15}(3x^2-x^3)\,\mathrm{d}x+\int_3^4 \frac{3}{10}(x-3)\,\mathrm{d}x$	M1
	$\frac{3}{20}(4^2)-\frac{9}{10}(4)+\frac{7}{4}-\left(\frac{1}{15}(2^3)-\frac{1}{60}(2^4)-\frac{1}{20}\right)=\underline{\frac{1}{3}}$	A1
		(2)
(d)	$1-\mathrm{F}(k)=0.2$ or $\int_k^5 \frac{3}{10}(x-3)\,\mathrm{d}x=0.2$	M1
	$\frac{3}{20}k^2-\frac{9}{10}k+\frac{7}{4}=0.8$ or $\frac{3}{20}(k-3)^2=0.4 \rightarrow k=4.63299\ldots$ awrt **<u>4.63</u>**	dM1 A1
		(3)
	Notes	**Total [14]**

2(a) (i) $P(X=3) = 120p^3(1-p)^7$

(ii) $P(X=3) = 16P(X=7)$

$\therefore \cancel{120}p^3(1-p)^7 = 16 \times \cancel{120}p^7(1-p)^3$

$\therefore p^3(1-p)^7 = 16p^7(1-p)^3$

$\div p^7(1-p)^3 \Rightarrow \dfrac{(1-p)^4}{p^4} = 16$

$\therefore (1-p)^4 = 16p^4$

$\therefore 1-p = 2p \Rightarrow p = \dfrac{1}{3}$

(b) $P(Y=3) = 5P(Y=5)$

$\therefore \dfrac{\cancel{e^{-\lambda}}\lambda^3}{6} = 5 \times \dfrac{e^{-\lambda}\lambda^5}{120}$

$\dfrac{\lambda^3}{6} = \dfrac{\lambda^5}{24} \Rightarrow 24\lambda^3 = 6\lambda^5$

$\therefore \dfrac{1}{4}\lambda^2 = 1 \Rightarrow \lambda^2 = 4$

$\therefore \lambda = 2$

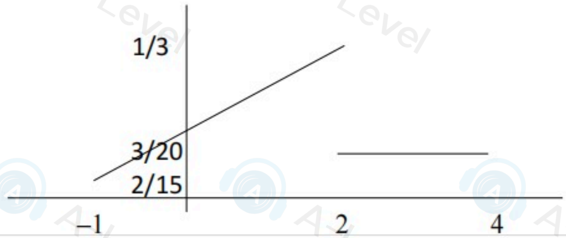
DO NOT WRITE IN THIS AREA

(c) $W \sim B(n, 0.4)$

$np = 0.4n = 32 \Rightarrow \underline{n = 80}$

$np(1-p) = 0.4n(1-0.4) = 0.24n = 19.2$

$\therefore x = \underline{19.2}$

Number		
4 (a)		M1 A1
		(2)
(b)	$[\mathrm{P}(G \leqslant 2)=]1-2\times\frac{3}{20}[=0.7]$ or $\frac{1}{2}\times3\times\left(\frac{2}{15}+\frac{1}{3}\right)$ or $\frac{1}{15}\int_{-1}^{2}(g+3)\,\mathrm{d}g[=0.7]$ or $\frac{1}{30}\times2^2+\frac{1}{5}\times2+\frac{1}{6}[=0.7]$ or $\left[\mathrm{P}\left(G\leqslant\frac{1}{2}\right)\right]=\frac{1}{2}\times1.5\times\left(\frac{2}{15}+\frac{3.5}{15}\right)[=0.275]$ or $\frac{1}{15}\int_{-1}^{0.5}(g+3)\,\mathrm{d}g[=0.275]$ or $\frac{1}{30}\times0.5^2+\frac{1}{5}\times0.5+\frac{1}{6}[=0.275]$ or $\left[\mathrm{P}\left(\frac{1}{2}\leqslant G\leqslant 2\right)=\right]\ \frac{1}{2}\times1.5\times\left(\frac{7}{30}+\frac{1}{3}\right)[=0.425]$ or $\frac{1}{15}\int_{0.5}^{2}(g+3)\,\mathrm{d}g[=0.425]$ or $\frac{1}{30}\times\left(2^2-0.5^2\right)+\frac{1}{5}\times(2-0.5)[=0.425]$	M1
	$[\mathrm{P}(1\leqslant 2G\leqslant 6\mid G\leqslant 2)=]\frac{\mathrm{P}\left(\frac{1}{2}\leqslant G\leqslant 2\right)}{\mathrm{P}(G\leqslant 2)}=\frac{0.425}{0.7}$ or $1-\frac{0.275}{0.7}$ oe	M1M1
	$=\frac{17}{28}$ or $0.607\ldots$ awrt 0.607	A1
		(4)
(c)	$\left[\mathrm{E}\left(H^2\right)=\right]2.4+12^2[=146.4]$	M1
	$\left[\mathrm{E}(G)=\right]\int_{-1}^{2}\frac{1}{15}\left(g^2+3g\right)\mathrm{d}g+\int_{2}^{4}\frac{3}{20}g\ \mathrm{d}g$	M1
	$\left[\mathrm{E}(G)=\right]\left(\frac{1}{15}\left(\frac{1}{3}g^3+\frac{3}{2}g^2\right)\right)_{-1}^{2}+\left(\frac{3}{40}g^2\right)_{2}^{4}$	M1
	$=\frac{1}{15}\left(\frac{8}{3}+\frac{12}{2}+\frac{1}{3}-\frac{3}{2}\right)+\left(\frac{48}{40}-\frac{12}{40}\right)[=1.4]$	dM1
	$\left[\mathrm{E}\left(2H^2+3G+3\right)=\right]2\times\text{"}146.4\text{"}+3\times\text{"}1.4\text{"}+3$	M1
	$=300$	A1 (6)
		Total 12

Question	Scheme	Marks
1.(a)	$1-\mathrm{F}(4) = 1-\frac{1}{16}(4-1)^2 = \frac{7}{16}$	M1 A1
		(2)
(b)	$[\mathrm{P}(X>3 \mid 2<X<4)=]\ \dfrac{\mathrm{F}(4)-\mathrm{F}(3)}{\mathrm{F}(4)-\mathrm{F}(2)} = \dfrac{\frac{9}{16}-\frac{4}{16}}{\frac{9}{16}-\frac{1}{16}} = \dfrac{5}{8}$	M1 dM1 A1
		(3)
(c)	$\mathrm{f}(x) = \frac{\mathrm{d}}{\mathrm{d}x}\mathrm{F}(x) = \frac{1}{8}(x-1)$	M1
	$\mathrm{E}(X) = \int_1^5 \frac{1}{8}x(x-1)\,\mathrm{d}x$	dM1
	$\mathrm{E}(X) = \left[\frac{1}{24}x^3 - \frac{1}{16}x^2\right]_1^5 = \left(\dfrac{5^3}{24}-\dfrac{5^2}{16}\right)-\left(\dfrac{1}{24}-\dfrac{1}{16}\right) = \dfrac{11}{3}$	dM1 A1
		(4)
		Total 9