Qu	Scheme	Marks	AO
1. (a)	From [5,20) fd = 3 or 1 large square = 2.5 passengers o.e.	M1	2.2a
	Correct bar above [0, 5)	A1	1.1b
	Correct bar above [20, 40)	A1	1.1b
		(3)	
(b)	For [40, 65) **130** passengers or for [65, 80) **60** passengers	M1	2.1
	For attempt to find total number of passengers = **331**	A1ft	1.1b
	[Median =] $40+\frac{\frac{1}{2}("331")-140}{"130"}\times 25$ or $65-\frac{270-\frac{1}{2}("331")}{"130"}\times 25$ (o.e.)	M1	1.1b
	= 44.9038… = awrt **44.9**	A1	1.1b
		(4)	
(c)	Upper outlier limit = $58.9 + 1.5\times(58.9 - 27.3) = 106\ (.3) > 90$	M1	2.4
	So oldest passenger is not an outlier	A1	2.2a
		(2)	
		(9 marks)	

	Notes
(a)	M1 for attempt at fd or a suitable method to deduce the scale for the histogram May be implied by one correct bar. 1st A1 for first bar [0, 5) with fd = 1 or 2 large squares high 2nd A1 for third bar with fd = 4.5 or 9 large squares high
(b)	1st M1 for an attempt using their fd to find the missing frequencies. May be in table 1st A1ft for a clear attempt to find the total number of passengers (ft their 130 and 60) 2nd M1 for any expression/equation leading to correct Q_2 Must be using 40-65 class 2nd A1 for awrt 44.9 (allow $(n + 1)$ leading to 45)
(c)	M1 for finding the upper outlier limit (expression or awrt 106) and stating or implying > 90 A1 dep on M1 seen for deducing NOT an outlier

Qu	Scheme	Mark	AO
2. (a)			
	$[Q_2 =](3.5)+\frac{\frac{256}{2}-"125"}{"55"}\times(4.5-3.5)$ <u>or</u> $(4.5)-\frac{"180"-\frac{256}{2}}{"55"}\times 1$	M1	2.1
	$= 3.5545\ldots\ldots$ awrt **<u>3.55</u>**	A1	1.1b
		(4)	
(b)	Need area under curve to be 256 so $\int_{(0)}^{(8)} kx(8-x)\,dx = 256$	M1	3.1a
	$k\left[4x^2-\frac{x^3}{3}\right]_{(0)}^{(8)} = 256$	M1	1.1b
	$\left\{k\left[4\times 8^2-\frac{8}{3}\times 8^2\right]=256\Rightarrow\right\}$ **<u>k = 3</u>**	A1	1.1b
		(3)	
(c)	[By symmetry median =] **<u>4</u>**	B1	2.2a
		(1)	
		(8 marks)	

Notes

(a)

1st M1 for an attempt to form frequency table (at least 1st 4 rows and freq <u>or</u> cum freq seen must have the frequency of 75 correct and can condone one error/omission in 15, 35, 55)
Frequencies or cum freq may be seen on bars of the histogram

1st A1 for identifying class, freq and cum freq (i.e. highlighted values from the table) <u>or</u> sight of 3.5-4.5, freq of 55 and "128" – 125 or 180 – "128"
<u>or</u> diagram with 125, "128", 180, 3.5 & 4.5
May be implied by values in 2nd M1expression

2nd M1 for a correct calculation for Q_2 (condone error in end point e.g. 3.45 or 3.49 etc)
Can ft their "125" (provided > 100) and their "55"
Allow use of $(n + 1)$, usually see 128.5 – … leading to 3.5636… or awrt 3.56

2nd A1 awrt 3.55 but 3.555 is fine (allow 3.56 if $(n + 1)$ being used …need sight of $\frac{257}{2}$ etc)
Correct answer with no incorrect working scores 4/4

(b)

1st M1 for identifying the need to find the area under the curve by integrating
2nd M1 for correct integration and = 256 (condone missing limits)
A1 for $k = 3$ [May see use of calculator for the integration so score 2nd M1A1 together]

(c)

NB The answer to part (c) may be written within the question.

B1 for 4 (Independent of their value of k but must be their "x" value)
NB when $k = 0.25$ and $x = 4$ gives $y = 4$ so must be clear they intend median = 4
The statement in part (c) "$k = 4$" is B0

Question	Scheme	Marks	AOs
3(a)	$61\times(2\times3),\quad 63\times(2\times12),\quad 65\times(2\times8),\quad 67\times(2\times2)$	M1	2.1
	$\dfrac{61\times(2\times3)+63\times(2\times12)+65\times(2\times8)+67\times(2\times2)}{50}=63.72*$	A1*cso	1.1b
		(2)	
(b)	$\sqrt{\dfrac{61^2\times6+63^2\times24+65^2\times16+67^2\times4}{50}-63.72^2}$	M1	1.1b
	$=\sqrt{2.5216}=1.58795...$ = awrt **1.59**	A1	1.1b
		(2)	
(c)	No effect (oe) since…e.g. • since addition/subtraction does not affect the standard deviation (only multiplication and division do) • the weights will have the same spread • the distance of each weight from the mean will not have changed • they all change by the same amount	B1	2.4
		(1)	
			(5 marks)

Notes	
(a)	**M1:** at least 3 correct products seen (oe) Allow any 3 from 366, 1512, 1040, 268 **A1*cso:** correct expression for mean (which may be seen in stages) and given answer. $\frac{3186}{50}=63.72$ on its own is M0A0, but $\frac{3186}{50}=63.72$ following all 4 correct products seen can score M1A1
SC:	**B2:** $\dfrac{61\times3+63\times12+65\times8+67\times2}{25}=63.72*$ scores M1A1 on epen
(b)	**M1:** correct expression for the standard deviation including root Allow equivalent complete methods e.g. $\sqrt{\dfrac{6(61-63.72)^2+24(63-63.72)^2+16(65-63.72)^2+4(67-63.72)^2}{50}}$ NB: $\sum fx^2=203138$ **A1:** awrt 1.59 (allow s = awrt 1.60) Correct answer with no incorrect working scores 2 out of 2
SC:	**B2:** $\sqrt{\dfrac{61^2\times3+63^2\times12+65^2\times8+67^2\times2}{25}-63.72^2}$ = awrt 1.59 scores M1A1 on epen
(c)	**B1:** correct statement and correct explanation

Qu 4	Scheme	Marks	AO
(a)	$2\times4.2\,,\,4\times4\,,\,4\times3.5\,,10\times1$ $(=8.4+16+14+10=48.4)$	M1	1.1b
	[So P($10 < T < 30$) =] $\left[\frac{48.4}{90}\right]=\frac{121}{225}=0.53777...$ **0.53~0.54** (2sf OK)	A1	1.1b
		(2)	
(b)	(Not suitable as) data is not symmetric or is skew (normal is symmetric) ("Even" distribution or a diagram on its own is not enough so B0)	B1 **(1)**	2.4
(c)	$\int xe^{-x}\ (dx)=\int x\,d(-e^{-x})$	M1	2.1
	$=\left[-xe^{-x}\right]-\int\left(-e^{-x}\right)\ (dx)$ $(+c)$	A1	1.1b
	$\int_0^n xe^{-x}\ (dx)=\left[-xe^{-x}-e^{-x}\right]_0^n=\left(-ne^{-n}-e^{-n}\right)-\left[-(0)-1\right]$	dM1	1.1b
	$=\underline{1-(n+1)e^{-n}}$ (*)	A1cso*	1.1b
		(4)	
(d)	Require area = 90 i.e. $k\int_{(0)}^{(n)} xe^{-x}\,dx=90$ (ignore limits)	M1	3.1a
	Using the result in part (c) with $n = 4$ gives $k\left[1-5e^{-4}\right]=90$	M1	2.1
	(k =) **99**(.0729…) **(*)**	A1cso*	1.1b
		(3)	
(e)(i)	[P($10 < T < 30$) =] 0.64863… awrt **0.649**	B1	1.1b
		(1)	
(ii)	[No. of patients =] $(99)\left[\left(1-4e^{-3}\right)-\left(1-2e^{-1}\right)\right]$ $(=53.1..)$	M1	3.4
	Prob $=\frac{0.5366...\times99}{90}=0.59027...$[or 0.5907...] = awrt **0.590** or **0.591**	A1	3.2a
		(2)	
(f)	eg Patients might stay longer than 40 hours (Can ignore other comments unless clearly contradictory.)	B1 **(1)**	3.5b
		(14 marks)	

	Notes
(a)	M1 for an attempt to find the number between 10 and 30 (2 correct products or 48 or 48.4 seen) A1 for 2sf answer in [0.53 ~ 0.54] NB use of 48 gives 0.5333… [Correct ans implies 2/2]
(b)	B1 for a comment suggesting not suitable based on (lack of) symmetry or "not bell shaped"
(c)	1st M1 for attempting integration by parts in right direction. Must have $u = x$ and $v = \pm e^{-x}$ 1st A1 for a correct first step, correct first integration and expression for second integral 2nd dM1 (dep on 1st M1) for all integration attempted and some use of at least one limit * 2nd A1 for cso with no incorrect working seen. Minimum is correct int and use of limits seen.
(d)	1st M1 for realising need area under the curve (implied by the integral) = 90 2nd M1 for use of (c) with $n = 4$ and set = 90 May be implied by sight of 99.07… or better * A1cso for $k = 99$ or awrt 99.1 **NB** Allow use of $k = 99$ and show area = awrt 89.9 with a conclusion to score 3/3
(e)(i)	B1 for awrt 0.649
(ii)	M1 for use of (c) with $n = 1$ and $n = 3$ Don't need the 99. Implied by sight of awrt 0.54 A1 for awrt 0.590 or awrt 0.591 Allow 0.59 from correct working seen.
(f)	B1 eg for comment, in context, about the upper limit for time (t or x)(time/hour may be implied)