January 2018

Question 5			
(e)	$L \sim \text{Po}(40) \approx \text{N}(40, 40)$		B1 B1
	$\text{P}(L > 27) = \text{P}\left(Z > \dfrac{27.5 - 40}{\sqrt{40}}\right)$		M1 M1
	$\text{P}(Z > -1.98) = 0.9761$	**awrt 0.976**	A1
			(5)
			Total 15

June 2018

Question Number 5		
(b)	[Let Y be the number of cars that pull into the service station]	
	$Y \sim \text{N}(\lambda, \lambda)$	M1
	$\lambda = 0.6n$	B1
	$\text{P}(Y > 40) = 0.2266$	
	$\dfrac{40.5 - \lambda}{\sqrt{\lambda}} = 0.75$	M1M1 B1 A1
	$\lambda + 0.75\sqrt{\lambda} - 40.5 = 0$	
	$\sqrt{\lambda} = 6$	M1A1
	$n = 60$	A1
		(9)

October 2018

Question 2			
(d)	$C \sim \text{B}(150, 0.4) \rightarrow \text{N}(60, 36)$		M1
	$\text{P}(C \geq 75) = \text{P}\left(Z > \dfrac{74.5 - 60}{\sqrt{36}}\right)$ [$= \text{P}(Z > 2.416\ldots)$]		M1 M1
	$1 - 0.9922 = 0.0078$	awrt **0.0078**	A1
			(4)

January 2019

Question Number	Scheme	Marks
6. i.(a)	n is large and p is small	B1 (1)
(b)	$[X \sim \text{B}(3000, 0.0025) \rightarrow] \; Y \sim \text{Po}(7.5)$ $\text{P}(Y > 7) = 1 - \text{P}(Y \leq 7) = 1 - 0.5246 = 0.47536\ldots$ awrt **0.475**	B1 M1 A1 (3)
ii.(a)	A **list/database/register** of **all employees**	B1 (1)
(b)	The **probability** distribution of the **number of employees** that **cycle** to work [from all possible samples of 150]	B1 (1)
(c)	$D \sim \text{N}(60, 36)$ $\text{P}(C \leq \alpha) = \text{P}(Z \leq z) = 0.0668$ $\frac{\alpha - "60"}{"6"} = -1.5$ or $\frac{"60" - \alpha}{"6"} = 1.5$ **$\alpha = 51$**	B1 M1 B1 A1cao (4)
(d)	$\text{P}(C \leq 51) = \text{P}(D \leq 51.5)$ $\text{P}\left(Z \leq \frac{"51" - "60" + 0.5}{"6"}\right)$ $= \text{P}(Z \leq -1.42) = 1 - 0.9222$ $= 0.0778/0.0782\ldots$ awrt **0.078**	M1 A1 (2) **[12 marks]**

June 2019

Question Number		
1		
(e)	$Y \sim \text{Po}(23.75)$ oe $\Rightarrow$ approximately $Y \sim \text{N}(23.75, 23.75)$ $\text{P}(Y \geqslant 30) = \text{P}\left(Z > \frac{29.5 - 23.75}{\sqrt{23.75}}\right)$ $[= 1 - \text{P}(Z < 1.18)]$ $(= 1 - 0.8810) \;\; = 0.1190$ awrt 0.119	B1 M1 M1dM1 A1 (5)

October 2019

Question	
6	
(c)	Y = Number of bolts that cannot be used $Y \sim \text{B}(120, 0.05)$ can be approximated by Po(6) P(more than 117 bolts can be used) = $\text{P}(Y \leq 2)$ $\text{P}(Y \leq 2) = 0.06196\ldots$ awrt **0.062**	M1A1 dM1 A1 (4)

January 2020

Question Number			
1			
(d)(i)	The p(robability)/0.97 is not small oe		B1
			(1)
(ii)	$L \sim \text{Po}(3)$		B1
	$\text{P}(L \leq 4) = 0.8153$	awrt **0.815**	M1A1
			(3)

June 2020

Question Number			
3			
(b)	$F \sim \text{N}(54, 29.7)$		M1A1
	$\frac{c+0.5-54}{\sqrt{29.7}} \leq -1.6449$ **or** $\frac{d-0.5-54}{\sqrt{29.7}} \geq 1.6449$		M1M1B1 A1
	$c = 44$ and $d = 64$		A1cso
			(7)

January 2021

Question Number			
1			
(d)	$A \sim \text{Po}(10)$		B1
	$\text{P}(A \geqslant n) > 0.8$		
	$\text{P}(A \leqslant n-1) < 0.2$ or $\text{P}(A \leqslant 6) = 0.1301$....awrt 0.13 or $\text{P}(A \geqslant 7) = 0.8699$....awrt 0.87		M1
	$n = 7$		A1cao
			(3)

January 2021

Question Number			
3			
(c)(i)	$\lambda = 0.07n$		B1
	$A \sim \text{N}(0.07n, 0.07n)$		M1
	$\frac{3.5-"0.07n"}{\sqrt{"0.07n"}}$		M1
	$\frac{3.5-0.07n}{\sqrt{0.07n}} = -1.55$ or $"0.07n" - \left(1.55\sqrt{0.07}\right)\sqrt{n} - 3.5 = 0$		B1
	$n - \left(\frac{1.55}{0.07}\sqrt{0.07}\right)\sqrt{n} - \frac{3.5}{0.07} = 0 \Rightarrow n - 1.55\sqrt{\frac{n}{0.07}} - 50 = 0$		A1cso
			(5)
(ii)	$\sqrt{n} = \frac{\frac{1.55}{\sqrt{0.07}} \pm \sqrt{\left(\frac{1.55}{\sqrt{0.07}}\right)^2 + 4 \times 50}}{2}$ = awrt – 4.72… or awrt 10.6… ($4\sqrt{7}$)		M1
	$n = 112$		A1cao
			(2)

June 2021

Question Number	Scheme	Marks
6. (i)	$z = 1.25$	B1
	$\frac{187.5-\mu}{\sigma} = 1.25$	M1 M1 A1
	$187.5-\mu = 1.25\sigma$	
	$\mu = 225p$	M1
	$\sigma = \sqrt{225p(1-p)}$	M1
	$(187.5-225p)^2 = (1.25)^2 \times 225p(1-p)$ or $(150-180p)^2 = 225p(1-p)$ (o.e.)	M1
	e.g. $900(5-6p)^2 = 225(p-p^2) \Rightarrow 4(25-60p+36p^2) = p-p^2$ Leading to $145p^2-241p+100=0$ *	A1*
(ii)	$[(29p-25)(5p-4)=0 \Rightarrow]$ $p=0.8$ or $p=\frac{25}{29}$ (accept: 0.862(0689…))	M1
	[p =] **0.8** because 0.862 gives a mean greater than 188 (oe)	A1
		(10)
		Total 10

January 2022

Question Number			
1			
(b)	Y = faults in six weeks $\Rightarrow Y \sim N(36,36)$		B1
	$P(Y<32) = P\left(Z < \frac{31.5-36}{6}\right)$ $\left[= P(Z<-0.75)\right]$		M1 M1
	= 0.2266	awrt 0.227	A1
			(4)

June 2022

Question			
2			
(c)	$C \sim B(256, \frac{7}{16}) \approx N(112,63)$		M1 A1
	$P(C>125) \approx P\left(Z > \frac{125.5-112}{\sqrt{63}}\right)$		M1M1
	$P(Z>1.70) = 1-0.9554 = 0.0446$		A1
			(5)

October 2022

Question Number
4

(b)	$Y \sim N(56, 33.6)$	M1A1
	$\dfrac{n-0.5-"56"}{\sqrt{"33.6"}} = -1.98$	M1M1 B1
	$n = 45$	A1cao
		(6)

January 2023

Number
5

(c)	X = The number of defects per x meters	
	$X \sim N\left(\dfrac{x}{16}, \dfrac{x}{16}\right)$	B1
	$P(X < 26) = P\left(Z < \dfrac{25.5 - \frac{x}{16}}{\sqrt{\frac{x}{16}}}\right) = 0.5398$	M1
	$\dfrac{25.5 - \frac{x}{16}}{\frac{1}{4}\sqrt{x}} = 0.1$	B1 M1 A1ft
	$\dfrac{1}{16}x + \dfrac{1}{40}\sqrt{x} - 25.5 = 0 \rightarrow \sqrt{x} = 20 \quad (\text{or } \sqrt{x} = -20.4)$	M1
	$(\sqrt{x})^2 = 20^2$	M1
	$x = 400$	A1
		(8)

June 2023

Question Number	
1.	

(b)(i)	$J \sim \text{N}(240, 144)$	M1A1
	$\text{P}(X \leqslant 222) \sim \text{P}(J < 222.5) = \text{P}\left(Z < \dfrac{222.5 - 240}{\sqrt{144}}\right)$	M1M1
	$\text{P}(Z < -1.46) = 1 - 0.9279 =$ awrt **<u>0.0721 – 0.0724</u>**	A1 (5)
(ii)	n is large (oe) and p is close to 0.5	B1 (1)

June 2023

Question Number	Scheme	Marks
4. (a)	p is small	B1 (1)
(b)	Let N = number of candles **not** suitable for sale	
	$N \sim \text{B}(125, 0.02)$	M1
	$\approx C \sim \text{Po}(2.5)$	A1
	$\text{P}(C \leqslant 6)$	M1
	$= 0.9858$ awrt **<u>0.986</u>**	A1 (4)

October 2023

Question Number	Scheme	Marks
7(a)	$\dfrac{97.5 - \mu}{\sigma} = 1.25$ $\dfrac{85.5 - \mu}{\sigma} = -0.75$	M1 M1 M1 M1 M1
	$2\sigma = 12$	M1
	$\sigma = 6$ * $\quad [\mu = 90]$	dA1*
		(7)
(b)	$np = 90$ and $np(1-p) = 36$	M1
	$1 - p = 0.4$	M1
	$p = 0.6$ and $n = 150$	A1
		(3)

January 2024

Question Number
1

(d)	$X \sim N(21,21)$	B1
	$\left[P(X<19)=\right]P\left(Z \,,\, \frac{18.5-21}{\sqrt{21}}\right)\left[=-0.5455...\right]$ or $\left[P(X>23)=\right]P\left(Z \,\ldots \frac{23.5-21}{\sqrt{21}}\right)\left[=0.5455...\right]$	M1M1A1
	$= 0.2912$ (calc 0.29268…)*	A1*cso
		(5)
(e)	$Y \sim B(13, \text{“}0.29\text{”})$	M1
	$\left[P(Y=5)=\right] {}^{13}C_5 ("0.29")^5 (1-"0.29")^8 = 0.170465$ (calc 0.17317…) awrt 0.17	M1 A1
		(3)

January 2024

Question Number
2

(b)	$J \sim B(25,\ 0.05)$	
	$\left[P(J \ldots 4)=\right]1-P(J \,,\, 3)=1-0.9659$	M1
	$= 0.0341$ (calc 0.034090…) awrt 0.0341	A1
		(2)
(c)	$T \sim Po[200\times"0.0341"] = 6.82$ (calc 6.8181…)	M1
	$\left[P(T \ldots 2)=\right]1-P(X \,,\, 1)=1-\left(e^{-"6.82"}+e^{-"6.82"}\times"6.82"\right)$	M1
	$= 0.99146\ldots$ calc (0.99144…) awrt 0.991	dA1
		(3)