Question	Scheme	Marks
7 (a)	Let P = time to serve a customer at a standard checkout	
	$Q = P_1 + P_2 + P_3 \quad [Q \sim] \mathbf{N(720, 1200)}$	B1
	$\mathrm{P}(Q < 660) = \mathrm{P}\left(Z < \pm \frac{660 - "720"}{"\sqrt{1200}"}\right) \left[= \mathrm{P}(Z < -1.732...)\right]$	M1
	$= 0.0418$ (Calculator gives 0.04163…) **awrt 0.041 / 0.042**	A1
		(3)
ALT	for the B1 M1 B1 for $[Q \sim] \mathrm{N}\left(12, \frac{1}{3}\right)$ M1 for $\mathrm{P}(Q < 11) = \mathrm{P}\left(Z < \pm \frac{11 - "12"}{\sqrt{"1/3"}}\right) \left[= \mathrm{P}(Z < -1.732...)\right]$	
(b)	Assume the time taken to serve customers is independent	B1
		(1)
(c)	R = time to serve a customer at an express checkout	
	$S = (P_1 + P_2 + P_3) - (R_1 + ... + R_7) \quad [S \sim] \mathbf{N(20, 1648)}$	M1 A1
	$\mathrm{P}(S > 0) = P\left(Z > \pm \frac{0 - 20}{"\sqrt{1648}"}\right) \left[= P(Z > -0.492...)\right]$	M1
	$= 0.6879$ (Calculator gives 0.6888…) **awrt 0.688 / 0.689**	A1
ALT	For the M1A1M1 M1 for $\mathrm{N}\left(\frac{1}{3}, ...\right)$ A1 for $\mathrm{N}\left(\frac{1}{3}, \frac{103}{225}\right)$ M1 for $\pm \frac{0 - 1/3}{"\sqrt{103/225}"}$	
		(4)

	Notes	**Total 8**
(a)	**B1**	For $\mathrm{N}(720, 1200)$ or $\mathrm{N}\left(12, \frac{1}{3}\right)$ Maybe awarded if used in standardisation
	M1	For standardising using 660, their mean $\neq$ 240 or 4 and their standard deviation $\neq$ 20 or $\frac{1}{3}$. If no distribution given the mean and sd must be correct in the standardisation. Allow $\pm$ stand
	A1	awrt 0.041 or awrt 0.042
(b)	**B1**	A correct assumption. Must have context of customers or time and independence(allow random)
(c)	**M1**	For N(±20, ….) or $\mathrm{N}\left(\frac{1}{3}, ...\right)$ maybe awarded in standardisation
	A1	For N(±20, 1648) or $\mathrm{N}\left(\frac{1}{3}, \frac{103}{225}\right)$ maybe awarded if used in standardisation
	M1	For standardising using 0 and mean of $\pm$ 20 or $\pm$ 1/3 and their standard deviation. The 0 may be implied by having just the mean on the numerator Allow $\pm$ stand
	A1	awrt 0.688 to 0.689

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