Question Number	Scheme	Marks
7. (i)	$A \sim \mathrm{N}(21, 2^2)$, $B \sim \mathrm{N}(32, 7^2)$ and $C \sim \mathrm{N}(45, 9^2)$ A, B, C are independent.	
(a)	$T = A + B + C$	
	$\mathrm{E}(T) = 21 + 32 + 45\,[= 98]$ or $\mathrm{Var}(T) = 2^2 + 7^2 + 9^2\,[= 134]$ — A fully correct method of finding $\mathrm{E}(T)$ or $\mathrm{Var}(T)$	M1
	$\mathrm{E}(T) = 98$ and $\mathrm{Var}(T) = 134$ — Both $\mathrm{E}(A) = 98$ and $\mathrm{Var}(A) = 134$	A1
	{So $T \sim \mathrm{N}(98, 134)$}	
	$\{\mathrm{P}(T > 90) =\}\ \mathrm{P}\left(Z > \dfrac{90 - "98"}{\sqrt{"134"}}\right)$ — Standardising $(\pm)$ with their mean and their standard deviation	M1
	$= \mathrm{P}(Z > -0.69109...)$	
	$= 0.7549$ (or 0.75525...) — awrt **0.755**	A1
		[4]
(b)	$\{\mathrm{P}(A > B) = \mathrm{P}(A - B > 0)\}$	
	$\mathrm{E}(A - B) = 21 - 32\,[= -11]$ or $\mathrm{Var}(T) = 2^2 + 7^2\,[= 53]$ — A fully correct method of finding $\mathrm{E}(A - B)$ or $\mathrm{Var}(A - B)$	M1 o.e.
	$\mathrm{E}(A - B) = -11$ and $\mathrm{Var}(A - B) = 53$ — Both $\mathrm{E}(A - B) = -11$ and $\mathrm{Var}(A - B) = 53$	A1 o.e.
	{So $A - B \sim \mathrm{N}(-11, 53)$}	
	$\{\mathrm{P}(A - B > 0)\} \Rightarrow \mathrm{P}\left(Z > \dfrac{0 - "-11"}{\sqrt{"53"}}\right)$ — Standardising $(\pm)$ with their mean and their standard deviation	M1
	$= \mathrm{P}(Z > 1.510966...)$	
	$= 0.06539855\ldots$ (or 0.0655) — **0.0655** or awrt **0.0654**	A1
		[4]
(ii)	$\{\mathrm{P}(X_1 > \bar{X} + k\sigma) = 0.1 \Rightarrow \mathrm{P}(X_1 - \bar{X} > k\sigma) = 0.1\}$	
	$X_1 - \bar{X} = X_1 - \dfrac{(X_1 + X_2 + X_3 + X_4)}{4} = \dfrac{3X_1 - (X_2 + X_3 + X_4)}{4}$ — For writing or using $X_1 - \bar{X}$	M1
	$\mathrm{E}(X_1 - \bar{X}) = 0$ — Correct mean for $X_1 - \bar{X}$	A1
	$\mathrm{Var}(X_1 - \bar{X}) = \dfrac{9\sigma^2 + 3\sigma^2}{4^2}$ — Correct expression for $\mathrm{Var}(X_1 - \bar{X})$	M1
	$X_1 - \bar{X} \sim \mathrm{N}(0, 0.75\sigma^2)$ — Correct distribution for $X_1 - \bar{X}$ May be implied by standardisation	A1
	$\left\{\mathrm{P}(X_1 - \bar{X} > k\sigma) = 0.1 \Rightarrow \mathrm{P}\left(Z > \dfrac{k\sigma - 0}{\sqrt{0.75\sigma^2}}\right) = 0.1\right\}$	
	So, $\dfrac{k}{\sqrt{0.75}} = 1.2816$ — Standardising with their $\mathrm{Var}(X_1 - \bar{X})$ (must be in terms of σ^2) Note that σ must cancel.	M1
	1.2816 or better	B1
	$\{k = \sqrt{0.75}\,(1.2816)\} \Rightarrow k = 1.109898157...$ — Dep on all previous M marks for awrt **1.11**	A1
		[7]
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