

Question	Answer	Marks	Guidance
(a)	$[P(10, 11, 12) =]$ ${}^{12}C_{10} 0.72^{10} 0.28^2 + {}^{12}C_{11} 0.72^{11} 0.28^1 + {}^{12}C_{12} 0.72^{12} 0.28^0$	M1	One term ${}^{12}C_x p^x (1-p)^{12-x}$, for $0 < x < 12$, $0 < p < 1$.
	$= 0.193725 + 0.0905726 + 0.0194084$	A1	Correct expression, accept unsimplified, no terms omitted, leading to final answer.
	0.304	B1	Final answer $0.3036 < p \leq 0.304$.
	Alternative method for question (a)		
	$[1 - P(0,1,2,3,4,5,6,7,8,9) =]$ $1 - ({}^{12}C_0 0.72^0 0.28^{12} + {}^{12}C_1 0.72^1 0.28^{11} + {}^{12}C_2 0.72^2 0.28^{10} +$ ${}^{12}C_3 0.72^3 0.28^9 + {}^{12}C_4 0.72^4 0.28^8 + {}^{12}C_5 0.72^5 0.28^7 +$ ${}^{12}C_6 0.72^6 0.28^6 + {}^{12}C_7 0.72^7 0.28^5 + {}^{12}C_8 0.72^8 0.28^4 +$ ${}^{12}C_9 0.72^9 0.28^3)$	M1	One term ${}^{12}C_x p^x (1-p)^{12-x}$, for $0 < x < 12$, $0 < p < 1$.
		A1	Correct expression, accept unsimplified, no terms omitted, leading to final answer.
	0.304	B1	Final answer $0.3036 < p \leq 0.304$.
(b)		3	
	Mean = $[0.52 \times 90 =]46.8$, var = $[0.52 \times 0.48 \times 90] = 22.464$	B1	46.8 and 22.464 or 22.46 seen, allow unsimplified, $(4.739 < \sigma \leq 4.740)$ imply correct variance).
	$[P(X < 40) =] P\left(z < \frac{39.5 - 46.8}{\sqrt{22.464}}\right)$	M1	Substituting <i>their</i> mean and <i>their</i> variance into \pm standardisation formula (any number for 39.5), not σ^2 , $\sqrt{\sigma}$.
		M1	Using continuity correction 39.5 or 40.5 in <i>their</i> standardisation formula.
	$= [P(Z < -1.540)] = 1 - 0.9382$	M1	Appropriate area Φ , from final process, must be probability.
	0.0618	A1	$0.06175 \leq p \leq 0.0618$
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