Normal Distribution 1

1	**(i)** $z_1 = \frac{70 - 66.4}{5.6} = 0.6429$	M1		Standardising one variable, no cc, no sq rt
	$z_2 = \frac{72.5 - 66.4}{5.6} = 1.089$	M1		Correct area $\Phi_2 - \Phi_1$
	$\Phi(1.089) - \Phi(0.643) = 0.8620 - 0.7399$ $= 0.1221$	A1		Correct answer rounding to 0.12
	$0.1221 \times 250 = 30.5$	M1		Mult by 250
	30 or 31 sheep	A1ft	**5**	Correct answer ft their 0.1221
	(ii) $66.4 - 59.2 = 7.2$	M1		Subt from 66.4
	$66.4 + 7.2 = 73.6$	A1	**2**	Correct answer
	(iii) $z = 0.674$	B1		± 0.674 or 0.675 seen
	$\frac{67.5 - \mu}{4.92} = 0.674$	M1		Standardising with a z-value no cc no sq rt
	$\mu = 64.2$	A1	**3**	Correct answer

2	**(a) (i)** $P(x < 8) = P\left(z < \frac{8 - 7.15}{0.88}\right)$	M1		Standardising ±, no cc no sq rt no sq
	$= \Phi(0.9659)$ $= 0.833$	A1	**2**	Correct answer
	(ii) $z = 0.674$	B1		Accept ± 0.674 or 0.675 only
	$\frac{q - 7.15}{0.88} = 0.674$	M1		Standardised eqn = ± their z-value, allow sq or sq rt if already penalised in **(i)**
	$q = 7.74$	A1	**3**	Correct answer
	(b) $P(Y > 4\mu) = P\left(z > \left(\frac{4\mu - \mu}{(3\mu/2)}\right)\right) = P(z > 2)$	M1		Standardising no sq rt, no cc, no sq, one variable
	$= 1 - 0.9772$ $= 0.0228$	A1		$z = \pm 2$ seen
		A1	**3**	correct ans SR B1 if made-up values used and 0.0228 obtained

3	$z = -2.326$	B1		± 2.325 to ± 2.33 seen
	$\frac{250 - 260}{\sigma} = -2.326$	M1		Standardising and = or < their z, no cc, sq, sq rt
	$\sigma = 4.30$	A1	**3**	Correct ans

4	**(i**	$P(<1.2)=P\left(z<\frac{1.2-1.9}{0.55}\right)=P(z<-1.2727)$	M1	Standardising for wt 1.2 or 2.5, no cc, sq, sq rt May be awarded in (ii) if not attempted in (i)
		$=1-\Phi(1.273)=1-0.8986$ $=0.1014$	A1	Accept 0.102 First correct proportion seen
		$P(>2.5)=P\left(z<\frac{2.5-1.9}{0.55}\right)=P(z>1.0909)$		
		$=1-\Phi(1.0909)=1-0.8623$ $=0.138$	A1	Second correct proportion seen
		$P(1.2<wt<2.5)=1-0.101-0.138$	M1	Third proportion 1 – their previous 2 proportions or correct attempt for remaining proportion
		$=0.761$	A1√ **5**	Correct answer or 1 – *their* 2 previous correct proportions
	(ii)	$P(x>k)=0.8+0.1377=0.9377$	M1	Valid method to obtain $P(x>k)$ or $P(x<k)$
		$z=-1.536$	A1	± 1.536 seen accept 3sf rounding to 1.53 or 1.54
		$-1.536=\frac{k-1.9}{0.55}$	M1	Attempt to solve equation with their 'correct' area z value, *k,* 1.9 and 0.55
		$k=1.06$	A1 **4**	Correct answer or rounding to 1.05

5	**(i**	$z=-1.406$	B1	Rounding to ±1.41 seen
		$\frac{c-14.2}{3.6}=-1.406$	M1	Standardising allow sq rt no cc
		$c=9.14$	A1 **3**	Correct answer
	(ii)	$P\left(\frac{15-14.2}{3.6}\right)<z<\left(\frac{16-14.2}{3.6}\right)$	M1	2 attempts at standardising no cc no sq rt
		$=\Phi(0.5)-\Phi(0.222)$ $=0.6915-0.5879$	M1	Subt two Φs (indep mark)
		$=0.1036$	A1	Needn't be entirely accurate, rounding to 0.10
		$P(\text{at least 2})=1-P(0,1)$	M1	Binomial term with ${}_7C_r p^r(1-p)^{7-r}$ seen $r\neq 0$ any $p<1$
		$=1-(0.8964)^7-(0.8964)^6(0.1036){}_7C_1$ $=1-0.8413$	M1	1 – P(0), 1 – P(1), 1 – P(0, 1) seen their p
		$=0.159$	A1 **6**	Correct answer accept 3sf rounding to 0.16

6	$P(x < -2.4) = P\left(z < \frac{-2.4-1.5}{3.2}\right)$	M1		Standardising no cc can have sq
	$= P(z < -1.219)$ $= 1 - 0.8886$	M1		Correct area, i.e. < 0.5
	$= 0.111$	A1	**[3]**	Correct answer rounding to 0.111

7	$P(13.6 < X < 14.8) = P\left(\frac{13.6-14}{0.52} < z < \frac{14.8-14}{0.52}\right)$	M1		Standardising 1 expression, no cc, no sq rt, no sq, ±, mean on num.
	$= P(-0.7692 < z < 1.538)$ $= \Phi(1.538) - [1 - \Phi(0.7692)]$ $= 0.9380 - [1 - 0.7791]$ $= 0.7171$	M1		$\Phi 1 + \Phi 2 - 1$ (indep) oe ($\Phi 2 - \Phi 1$ if cc used)
		A1		Correct probability rounding to 0.72 here
	$P(8) = (0.7171)^8(0.2829)^2{}_{10}C_8$	M1		Binomial expression $10C8\ p^8q^2$, $\Sigma p + q = 1$, any p
	$= 0.252$	A1	**5**	Correct answer (rounding to 0.252)