Normal Distribution 3

1	**(i** $z = 1.882$ or 1.881	B1		±1.882 or ±1.881 seen
	$1.882 = (32 - 20) / \sigma$	M1		Equation using their z (must be a z-value) 32, 20 and s
	$\sigma = 6.38$	A1	[3]	Correct answer
	(ii) $P(x > 13) = P\left(z > \frac{13-20}{6.376}\right)$	M1		Standardising
	$= P(z > -1.0978)$	M1		Correct area > 0.5
	$= 0.864$	A1	[3]	Correct answer
	(iii) P(at least 2) = 1 – P(0, 1)	M1		Using 0.03 and 0.97 or 0.06 and 0.94 in a binomial expression powers summing to 7
	$= 1 - (0.97)^7 - (0.03)(0.97)^6 {}_7C_1$	M1		Correct unsimplified binomial expansion
	$= 0.0171$	A1	[3]	Correct answer

2	**(i** $z_1 = \frac{12-8}{\sqrt{24}} = 0.816$ $\Phi_1(0.816) = 0.7926$	M1		Standardising any one, no sq rt no cc
	$z_2 = \frac{7-8}{\sqrt{24}} = -0.204$ $\Phi_2(-0.204) = 1 - 0.5808$	M1		Correct area $\Phi_1 + \Phi_2 - 1$
	Prob = 0.7926 – (1 – 0.5808) = 0.373	A1	[3]	Correct answer
	(ii) $z = \frac{0-\mu}{2\mu} = -0.5$	M1		Standardising, no cc no sq rt, one variable
	$P(z < -0.5) = 1 - 0.6915$			
	$= 0.309$ or 30.9%	A1	[2]	Correct answer oe
	(iii) $z = \frac{3\mu-\mu}{2\mu} = 1$	M1		Standardising and eliminating μ
	$P(z > 1) = 1 - 0.8413 = 0.1587$	M1		Subt from 1 and multiplying by 70
	$70 \times 0.1587 = 11.1$	A1	[3]	Correct answer accept 11 or 12
	(iv) $z = 1.45$	B1		± 1.45 seen
	$1.45 = \frac{6-\mu}{2\mu}$	M1		Solving for μ with 6, 2 μ , μ and their z
	$\mu = 1.54$	A1	[3]	Correct answer

3 **(i**	$z = 0.38$	B1	$\pm 0.38\,(0)$ seen or implied
	$\pm\dfrac{25-\mu}{\mu/3} = 0.38$	M1	Standardising attempt resulting in $z =$ some μ/σ/both, no continuity correction
		M1	Substituting to eliminate μ or σ and attempt to solve linear equation
	$\mu = 22.2,\ \sigma = 7.40$	A1 [4]	Both correct
(ii)	$P(4) = {}^6C_4(0.352)^4(0.648)^2$	M1	${}^6C_r \times (p)^r \times (1-p)^{6-r}$, $r = 2$ or 4
	$= 0.0967$	A1 [2]	Correct answer

4 **(i**	$P(X > 20) = P(z > -6.4/3.7)$ $= P(z > -1.730)$ $= 0.9582$	M1	Standardising no cc no sq rt
		A1	Prob rounding to 0.958
	Number of students = 335 or 336	A1ft [3]	Correct answer ft their prob, must be integer
(ii)	P(very slow) = 0.05	B1	0.05 or 0.95 seen
	$P(0, 1, 2) =$ $(0.95)^8 + {}^8C_1(0.05)^1(0.95)^7 + {}^8C_2(0.05)^2(0.95)^6$	M1	Binomial term with ${}^8C_r p^r (1-p)^{8-r}$ seen any p
		M1	Correct expression for P(0, 1, 2), p close to 0.05
	$= 0.6634 + 0.2793 + 0.0515$ $= 0.994$	A1 [4]	Answer rounding to 0.994

5 **(i**	Zotoc: $z = \dfrac{367-320}{21.6} = 2.176$ Ganmor: $z = \dfrac{367-350}{7.5} = 2.267$	M1	Standardising either car's fuel, no cc, no sq, no √
	P(Zotoc) = 0.985	A1	Correct answer
	P(Ganmor) = 0.988	A1 [3]	Correct answer
(ii)	$z = 0.23$	B1	± 0.23 seen
	$0.23 = \dfrac{x-320}{21.6}$	M1	Standardising either car, no cc, no sq rt, no sq
	$x = 324.968$	M1ind	$320 + d - 320$ i.e. just d on num
	$d = 4.97$	A1 [4]	Correct answer, –4.97 gets A0