The Normal Distribution - Answers

June 2017 Mathematics Advanced Paper 1: Statistics and Mechanics 1

1.

Question Number	Scheme	Marks
5. (a)	$[P(T > 20) =] \ P\left(Z > \dfrac{20-18}{5}\right)$	M1
	$P(Z > 0.4) = 1 - 0.6554$	M1
	$= \underline{\textbf{0.3446}} \text{ or awrt } \underline{\textbf{0.345}}$	A1
		(3)
(b)	Require $P(T > 20 \mid T > 15)$ or $\dfrac{P(T > 20)}{P(T > 15)}$	M1
	$\dfrac{\text{"(a)"}}{P\left(Z > \frac{15-18}{5}\right)} = \dfrac{\text{"(a)"}}{P(Z > -0.6)} \ , \ = \dfrac{\text{"0.3446"}}{0.7257} \text{ or } \dfrac{\text{"0.345"}}{0.726}$	M1, A1ft
	$= 0.47485... = \text{awrt } \underline{\textbf{0.475}}$	A1
		(4)
(c)	$P(T > d \mid T > 15) = 0.5$ or $P(T < d \mid T > 15) = 0.5$	M1
	$P(T > d)$ or $P(15 < T < d) = 0.5 \times "0.7257" = [0.36285]$	A1ft
	$P(T < d) = "0.63715"$	M1
	So $\dfrac{d-18}{5} = 0.35$ (calculator gives 0.35085...)	A1
	$d = 19.754... = \text{awrt } \underline{\textbf{19.8}}$	A1cso
	(Accept 19 mins 45(secs) or 19:45 but 19.45 is A0)	(5)
		[12]

		Notes
(a)	1st M1	for standardising with 20, 18 and 5. Accept $\pm$
	2nd M1	for attempting $1 - p$ [where $0.5 < p < 0.7$]. Beware $1 - 0.4$ (or their z value) is M0
	A1	for awrt 0.345 (Correct ans only 3/3)
(b)	1st M1	for either correct conditional probability statement (allow "in words" or any letter except Z)
		1st M1 can be implied by 2nd M1 so a mark of M0M1 should not be given.
	2nd M1	for using their (a) on num. and attempting to standardise $P(T > 15)$ (no $\pm$)on denom.
		Num.>Deno. is M0
		Allow one digit transcription errors from (a) e.g. 0.3464 or 0.3466 etc for 2nd M1 and 1st A1ft
	1st A1ft	for their 0.3446 on numerator and denominator of 0.7257 (or better: 0.7257469…)
		provided Num < Denom. Allow 0.726 on the denominator
		Sight of $\dfrac{"0.3446"}{0.7257 \text{ or } 0.726}$ will score M1M1A1ft
	2nd A1	for awrt 0.475
(c)	1st M1	for a correct conditional probability statement that includes the 0.5
	1st A1ft	for $P(T > d)$ or $P(15 < T < d) = 0.5 \times$ their $P(T > 15)$ [provided $P(T > 15) > 0.5$]
		Follow through (3sf) their $P(T > 15) = 0.7257$ or better from part (b). (Allow 0.726)
		Sight of $0.5 \times$ their $0.7257 = "0.36285"$ or better scores 1st M1 and 1st A1ft (Allow 0.363)
	2nd M1	(dep on 1st M1) for $P(T < d) = 1 - "0.36285"$ $\underline{or}$ "0.36285" $+ 1 - "0.7257$"
		$= [0.6371 \sim 0.6372]$
		Sight of their 0.63715 or better (calc: 0.637126…) scores first 3 marks (Allow 0.637)
	2nd A1	for $\dfrac{d-18}{5} = 0.35$ (or better) (Calc could give 0.350788…)
	3rd A1cso	for ($d =$) awrt 19.8 (accept 19.7 not awrt 19.7) **Must** come from correct work.
Beware!		$0.5 \times 0.7257 = 0.36285$ and using $\underline{this}$ (instead of 0.35) as z value leads to 19.8 but is A0A0