

11	(a)	Population large or	B1	or, eg Would take too long to contact all students.
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Question			Answer	Mark	Guidance
11	(b)		eg: Includes students from all years (or ages) Numbers in years in correct proportions Different years might like different music	[1]	NOT “Easier”
				B1	or: Different years may have different numbers of students NOT “It’s more representative” or “Takes all students into account” “You get a range of people” “It avoids bias”
11	(c)		21 + 2×4.2 = 29.4 22.9 + 1.5(22.9 – 18.0) = 30.25 Unclear whether 30 is an outlier	[1]	
				B1 B1 B1 [3]	Allow “30 is more than 2 sds away from the mean” Allow “30 is less than 1.5×IQR from UQ” or eg "It depends which definition you use." Any comment implying uncertainty Ignore comments about mean ± 3 sds or mean ± 1 sd
11	(d)		$H_0: \mu = 20$ $H_1: \mu > 20$ where μ = pop mean time spent oe $\bar{X} \sim N(20, \frac{4.2^2}{60})$ and $\bar{X} = 21$ $P(\bar{X} > 21) = 0.0326$ Compare 0.05	B1 B1 M1 A1 A1	NB Allow 2 sf throughout Allow other letters, not X unless defined. Not \bar{X} B1B0 for 1 error eg 2-tail or: 2-tail B1B0 μ = sample mean implied B1B0 undefined μ B1B0 Not include value 20 B0B0 not in terms of parameter B1B0 eg $H_0 = 20$ etc: B0B0 Correct distribution and value of \bar{X} . stated or implied eg by 0.0326 or 0.967 or 20.9 or 1.84 or 0.000335 even if within incorrect statement eg $P(X = 21) = 0.0326$ Condone $\frac{4.2^2}{\sqrt{60}}$ or $\frac{4.2^2}{60^2}$ or $\frac{4.2}{60}$ BC Allow 2 sf, ie 0.033 Dep 0.0326 or 1.84 or 0.9674 or $P(X > 21)$ or $P(X \geq 21)$ soi Must compare like with like,

Question			Answer	Mark	Guidance
					eg NOT prob of z -value or large prob of small prob or CV of wrong end of acceptance region
11	(d) ctd		Alternative methods for M1A1A1 or $\frac{a-20}{4.2 \div \sqrt{60}} = 1.645$ ($a = 20.9$) CV = 20.9 21 > 20.9 or 21 not in acceptance region	M1 A1 A1	Condone $\frac{4.2^2}{\sqrt{60}}$ or $\frac{4.2^2}{60^2}$ or $\frac{4.2}{60}$
			or $\frac{21-20}{4.2 \div \sqrt{60}}$ (= 1.84) $z_{calc} = 1.84$ Compare 1.645	M1 A1 A1	Condone $\frac{4.2^2}{\sqrt{60}}$ or $\frac{4.2^2}{60^2}$ or $\frac{4.2}{60}$
			$\bar{X} \sim N(20, \frac{4.2^2}{60})$ and $\bar{X} = \frac{1260}{60}$ or 21 $P(\bar{X} < 21) = 0.9674$ Compare 0.95	M1 A1 A1	Condone $\frac{4.2^2}{\sqrt{60}}$ or $\frac{4.2^2}{60^2}$ or $\frac{4.2}{60}$ BC
			Reject H_0 Condon Accept H_1 There is evidence that (mean) time spent is > 20 hours or eg there is evidence to support Zac's belief	M1 A1f	Dependent on clearly valid comparison of like with like. Dep 0.0485 or 0.951 or 20.9 or 1.84 or $P(X > 21)$ or $P(X \geq 21)$ so May be implied by conclusion, eg "There is evidence that mean time is > 20 hours" M1A1 In context, not definite; eg "Mean time is > 20 hours": A0 But "There is evidence to reject H_0 and that mean time is > 20 h"

Question			Answer	Mark	Guidance
					M1A1
				[7]	Allow opposite conclusion, ft their values, if above conditions met
			NB Use of $4.2^2/60$ as sd gives $p = 0.000335$		and loses 2 nd A1. But potentially can score all the other 6 marks