Non-parametric Tests 1 MS

Q1.

1(a)	When the population cannot be assumed to be normally distributed	1	B1	
1(b)	H_0: population median is 6.00, H_1: population median is greater than 6.00	1	B1	Both hypotheses stated
	Calculate deviations and resulting signed ranks	1	M1	
	(see table below)	1	A1	
	Test statistic $T = 8 + 7 + 5 + 3 + 4 + 1 = 28$	1	A1	
	Compare with correct critical value 17	1	M1	
	Conclusion: accept H_0; insufficient evidence that the median is greater than 6.00	1	A1FT	Conclusion to be stated in context, not just 'not significant'; follow through their value of T
		6		

Devs	−0.38	−0.27	0.55	0.81	0.10	−0.25	−0.13	0.47	−0.14	0.26	0.99	−0.09
Rank	−8	−7	10	11	2	−5	−3	9	−4	6	12	−1

Q2.

2(a)	H_0: population median is 6.40, H_1: population median $\neq 6.40$	B1
	Calculate differences and signed ranks	M1A1
	(see table below)	
	Test statistic $= 4 + 7 + 2 + 1 = 14$	A1
	Compare with correct critical value 8	M1
	Accept H_0: insufficient evidence to reject claim (**FT** *their* test statistic)	A1 FT
		6
2(b)	Symmetrically distributed about the median	B1
		1

0.04	−0.24	−0.78	−0.58	0.11	0.22	−0.21	0.02	−0.06	−0.12
2	−8	−10	−9	4	7	−6	1	−3	−5

Q3.

6(a)	Difference of location test for populations not known to be normal	B1
		1

6(b)		M1

10.6	2	10.5	1
11.1	7	10.7	3
11.8	12	10.8	4
12.0	14	10.9	5
12.1	15	11.0	6
12.2	16	11.2	8
12.3	17	11.3	9
12.4	18	11.6	10
13.2	21	11.7	11
13.5	22	11.9	13
13.8	23	12.5	19
13.9	24	12.6	20

Total ranks: 109 or 191	A1
H_0: $m_x = m_y$ H_1: $m_x > m_y$	B1
Use normal approximation with attempts at mean and variance	M1
mean $= 150$, variance $= 300$	A1

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Q4.

2(a)	H$_0$: $m = 200$ H$_1$: $m < 200$	B1	Allow 'median' in words, allow m not defined
	10 −14 −12 8 −16 −9 15 − 2 −4	M1	Signed differences (at most 3 errors)
	Ranks: 5 −7 −6 3 −9 −4 8 −1 − 2	A1	Award for correct rank order, ignore signs
	Sum ranks T = 16	A1	CWO
	Critical value 8 and compare '16' > 8	M1	Compare their T with 8
	Accept H$_0$ Insufficient evidence to support scientist's belief	A1	In context, all correct, except possibly hypotheses. Level of uncertainty in language used. No contradictions
		6	
2(b)	Magnitude of differences from median are taken into account	B1	Must mention magnitude and differences
		1	

Q5.

2(a)	H$_0$: difference in (population) medians = 0 H$_1$: difference in (population) medians < 0 (or >0)	B1 B1	Correct hypotheses (median or m) All notation identified e.g. m = population median if used
	Differences: −3 4 5 −1 −8 −19 −11 10 −13 −7 9 −16	M1	At most 3 errors
	Ranks: −2 3 4 −1 −6 −12 −9 8 −10 −5 7 −11	A1	Award for correct rank order, ignore signs
	Sum T = 3 + 4 + 8 + 7 = 22	A1	cwo
	Compare with critical value 17: '22' > 17	M1	Compare *their* T with 17
	Accept H$_0$ Data does not support student's claim	A1	In context, all correct, except possibly second B1 Level of uncertainty in language used. No contradictions.
		7	
2(b)	Rank for A becomes + 2,	M1	T = 24
	Changing sign of difference can only reduce evidence in favour of the claim.	A1	still > 17 and test result unchanged
		2	