1 The weights of the contents of packets of table salt are known to be normally distributed with standard deviation 6 g. The mean weight of the contents of a random sample of 4 packets was found to be 748 g. Calculate a 99% confidence interval for the mean weight of the contents of all packets. *(4 marks)*

Question Number and part	Solution	Marks	Total marks	Comments
1	$748 \pm 2.5758 \times 6/\sqrt{4}$	B1 M1 M1		2.5758 (2.57 ~ 2.58) attempt to use $6/\sqrt{4}$ completely correct method
	748 ± 7.73			748 ± 7.73 (7.72 ~ 7.74) or
	740.3 ~ 755.7	A1	4	740.3 (740 ~ 740.3) and 755.7 (755.7 ~ 756)
	Total		**4**	

2 A manufacturer makes batteries for use in bicycle lights. The working lives, in hours, of the batteries are known to be normally distributed with a standard deviation of 1.8. A random sample of batteries was tested and their working lives were as follows:

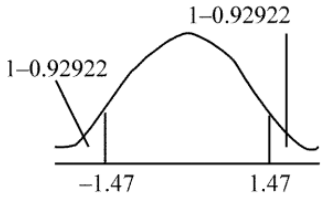
48.2 49.6 47.1 50.0 46.8 47.2 47.9

(a) Calculate a 95% confidence interval for the mean working life of the batteries. *(6 marks)*

(b) State the width of the confidence interval you have calculated. *(1 mark)*

(c) What percentage would be associated with a confidence interval of width 2 hours calculated from the given data? *(5 marks)*

(d) A further random sample of size seven is to be taken and used to calculate a confidence interval of width 2 hours. State the probability that this confidence interval will **not** contain the mean working life. *(1 mark)*

2(a)	$\bar{x} = 48.114$	B1		(48.1 - 48.12)
	95% confidence interval for mean			
	$48.114 \pm 1.96 \times \frac{1.8}{\sqrt{7}}$	B1		1.96
		M1		for use of $\frac{1.8}{\sqrt{7}}$
		m2		completely correct method, 'their' $\bar{x}$, z
	48.114 ± 1.333			
	$46.8 - 49.4$	A1	6	48.1 (48.1 - 48.12) and 1.33 (1.33 - 1.34) **or** 46.8 (46.7 - 46.8) and 49.4 (49.4 - 49.5)
(b)	2.67	B1	1	(2.66 - 2.68) cao
(c)	$\frac{2z \times 1.8}{\sqrt{7}} = 2$	M1		for any correct equation - allow small slip e.g. omission of first 2
	$z = 1.470$	m1		any completely correct equation
		m1		method of solution - requires M mark
	% confidence $= 100[1 - 2(1 - 0.92922)]$	m1		method for % confidence - requires M mark
	$= 85.8\%$	A1	5	(85 - 86)
(d)	0.142	B1√	1	'their' answer to (c)
	Total		**13**	

3 A health food co-operative imports a large quantity of dates and packs them into plastic bags labelled 500 grams. Georgina, a Consumer Protection Officer, checked a random sample of 95 bags and found the contents had a mean weight of 498.6 grams, and a standard deviation of 9.3 grams.

(a) Assuming that weights follow a normal distribution, calculate, for the mean weight of contents of all the bags:

(i) a 95% confidence interval; *(4 marks)*

(ii) an 80% confidence interval. *(2 marks)*

(b) The health food co-operative also imports raisins. Georgina intends to take a random sample of 500 gram packets of raisins, weigh the contents and use the results to calculate an 80% and a 95% confidence interval for the mean weight, μ, of the contents of all the co-operative's packets of raisins.

(i) Find the probability that:

(A) the 80% confidence interval contains μ; *(1 mark)*

(B) the 95% confidence interval contains μ but the 80% confidence interval does not. *(2 marks)*

(ii) Instead of calculating both confidence intervals from the same sample, Georgina now decides to calculate the 95% confidence interval from one sample and the 80% confidence interval from a second independent random sample. Find the probability that the 95% confidence interval contains μ but the 80% confidence interval does not. *(2 marks)*

Q	Solution	Marks	Total	Comments
3(a)	95% confidence interval	B1 M1		1.96 cao
(i)	$498.6 \pm 1.96 \times \frac{9.3}{\sqrt{95}}$			Use of $\frac{9.3}{\sqrt{95}}$
	498.6 ± 1.87	m1		Correct method - their z
	$496.7 - 500.5$	A1	4	496.7 (496.7–496.8) and 500.5 (500.4 –500.5) or 498.6± 1.87 (1.86–1.88) Allow 497 and 500
(ii)	80% confidence interval $498.6 \pm 1.2816 \times \frac{9.3}{\sqrt{95}}$	M1	2	Method - their z
	498.6 ± 1.22 $497.4 - 499.8$	A1		497.4 (497.3–497.4) and 499.8 (499.8 –499.9) or 498.6±1.22 (1.22 –1.23) Allow 497 and 500 but penalise if answers to (i) and (ii) are identical
(b)(i)	(A) 0.8	B1		0.8 cao
	(B) 0.15	M1		Method
		A1	3	0.15 cao
(ii)	$0.95 \times 0.2 = 0.19$	M1		
		A1	2	Method 0.19 cao
	Total		**11**	

6 Applicants to join a police force are tested for physical fitness. Based on their performance, a physical fitness score is calculated for each applicant. Assume that the distribution of scores is normal.

(a) The scores for a random sample of ten applicants were

55 23 44 69 22 45 54 72 34 66

Experience suggests that the standard deviation of scores is 14.8.

Calculate a 99% confidence interval for the mean score of all applicants. *(5 marks)*

(b) The scores of a further random sample of 110 applicants had a mean of 49.5 and a standard deviation of 16.5.

Use the data from this second sample to calculate:

(i) a 95% confidence interval for the mean score of all applicants; *(3 marks)*

(ii) an interval within which the score of approximately 95% of applicants will lie. *(2 marks)*

(c) By interpreting your results in parts (b)(i) and (b)(ii), comment on the ability of the applicants to achieve a score of 25. *(3 marks)*

(d) Give **two** reasons why a confidence interval based on a sample of size 110 would be preferable to one based on a sample of size 10. *(2 marks)*

(e) It is suggested that a much better estimate of the mean physical fitness of all recruits could be made by combining the two samples before calculating a confidence interval. Comment on this suggestion. *(3 marks)*

Question Number and part	Solution	Marks	Total	Comments
6(a)	$\bar{x} = 48.4$	B1		48.4 cao
	99% confidence interval			
	$48.4 \pm 2.5758 \times \frac{14.8}{\sqrt{10}}$	B1		2.5758 (2.57 – 2.58)
		M1		Use of $\frac{14.8}{\sqrt{10}}$ or $\frac{5}{\sqrt{10}}$
	ie 48.4 ± 12.1	m1		Completely correct method – candidate's z
	36.3 – 60.5	A1	5	36.3 (36.3 – 36.4) and 60.5 (60.4 – 60.5) **or** 48.4 and 12.1 (12–12.1)
(b)(i)	95% confidence interval			
	$49.5 \pm 1.96 \times \frac{16.5}{\sqrt{110}}$	B1		1.96
		M1		Method – their z
	49.5 ± 3.08	A1	3	49.5 ± 3.08 (3.08 – 3.09)
	46.42 – 52.58			**or** 46.42 (46.41– 46.42) and 52.58 (52.58 – 52.59) Allow 46.4 and 52.6
(ii)	$49.5 \pm 1.96 \times 16.5$	M1		Method – their z
	17.2 – 81.8	A1	2	49.5 ± 32.34 (32.3 – 32.4) **or** ± 17.2 (17.1 – 17.2) and 81.8 (81.8 – 81.9)
(c)	Mean greater than 25 but many	E1		Mean $\neq 25$
	individuals will be less than 25	E1		Mean > 25
		E1	3	Some individuals < 25
(d)	Interval narrower	E1		Interval narrower
	No need for normal assumption	E1	2	Normal not needed
(e)	Both samples random so valid suggestion.	E1		Valid
	Would be better but not much ($\frac{49.5}{\sqrt{110}}$	E1		Better
	very similar to $\frac{49.5}{\sqrt{120}}$)	E1	3	Not much Any three points
	Total		**18**	