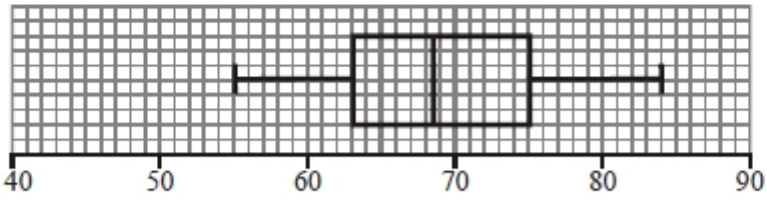
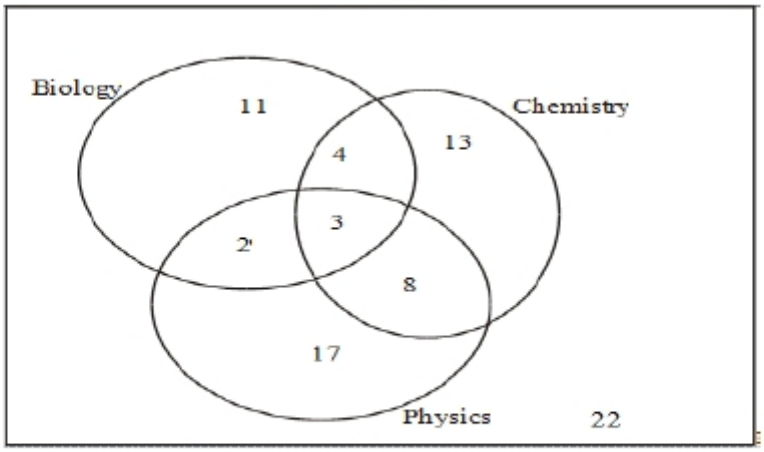
A level Statistics Paper 3 MARK SCHEME

Question 1

Question	Scheme	Marks
(a)	[Range = 48 − 9] = **39**	B1 (1)
(b)	[IQR = 25 − 12]= **13**	B1 (1)
(c)	Median = $65+\frac{[9]}{13}\times 5 = \frac{890}{13}$ = awrt **68.5°** $\left[\text{Condone: } 65+\frac{[9.5]}{13}\times 5 = 68.7\right]$	M1 A1 (2)
(d)	Lower Quartile = $60+\frac{9}{15}\times 5 = \mathbf{63}$ (*)	M1 A1c (2)
(e)(i)	$63-1.5\times(75-63)=45$ $75+1.5\times(75-63)=93$ No data above 93 and no data below 45 or 55>45 etc or there are no outliers.	M1A1 A1
(ii)		M1 A1ft (5)
(f)	Median for the 70°angle is closer (to 70°)[than the 20° median is to 20°] The range/IQR for the 70° angle box plot is smaller/shorter Therefore, students were more accurate at drawing the 70° angle.	B1 B1 dB1 (3) (14 marks)

	Notes
(c)	M1 for an attempt (should have 65 or 70, 13 and 5)NB working down: $70-\frac{[4]}{13}\times 5$ Allow any correct method leading to $\frac{890}{13}$, the "5" may be implied by 65 and 70 seen A1 awrt 68.5 (condone 68.7 if $(n+1)$ is used). Ans only of 68.5 is 2/2 but 68.7 needs M1
(d)	M1 for correct expression for the lower quartile (condone 9.25 if $(n+1)$ used) Watch out for working down e.g. $65-\frac{6}{15}\times 5$ (M1) but e.g. $\frac{60+65}{2}=62.5=63$ is M0 A1 for correct solution with no incorrect working seen (condone $(n+1)$ giving 63.08..)
(e)(i)	M1 for either correct calculation (may be implied by one correct limit) A1 for either 45 or 93 A1 for 45 and 93 and conclusion
(ii)	M1 for a box with 1 whisker drawn on each side (must see the line drawn) A1ft their median $63 < Q_2 < 75$ but quartiles (63 and 75), 55 and 84 must be correct.
Accuracy	Use 0.5 sq. accuracy so condone median on 68 or 69 if 68.5 seen
(f)	1st B1 for correct comparison of their **medians** (63 < (c) < 75) to true value 2nd B1 for correct comparison of their **range** or **IQR** ("spread" is B0) Allow saying IQRs of 12 and 13 are similar. Ignore mention of "skewness" or "outliers" 3rd dB1 dependent upon at least one previous B1 being scored for choosing 70°

Question 2

Question	Scheme	Marks
(a)		B1 M1 A1 A1 B1 (5)
(b)	$\frac{'13'}{80}$ or 0.1625	B1ft (1)
(c)	$\frac{28+30-11}{80}$ or $\frac{2+3+4+8+13+17}{80}$ or $1-\frac{(11+22)}{80}=\frac{47}{80}$ or 0.5875	M1 A1 (2)
(d)	$\frac{"17+8+13"}{"47"}$ or $\frac{\frac{"38"}{80}}{\frac{"47"}{80}}$ or $1-\frac{"2+3+4"}{"47"}=\frac{38}{47}$ (condone awrt 0.809)	M1 A1cao (2)
(e)	$P(B\|C)=\frac{7}{28}$, $P(B)=\frac{20}{80}$ $P(C\|B)=\frac{7}{20}$, $P(C)=\frac{28}{80}$ $P(B\cap C)=\frac{7}{80}$, $P(B)=\frac{20}{80}P(C)=\frac{28}{80}$ $P(B\|C)=P(B)$, $P(C\|B)=P(C)$ these may be implied by correct conclusion $P(B\cap C)=P(B)\times P(C)$ this approach requires the product to be seen So, they are independent.	M1 M1 A1 (3) (13 marks)

	Notes
(a)	B1 for 3 intersecting circles with 3 in the centre. **Allow probs. or integers in diagram.** M1 for some correct subtraction e.g. at least one of 2, 4, 8 or for B: 20 – their(2+3+4) etc A1 for 2, 4 and 8 (ignore labels) A1 for 11, 13 and 17 (must be in compatible regions with 2, 4, 8 if no labels) B1 for correct labels and 22 and box (Do not treat "blank" as 0 so can't use 0 for ft in (c))
(c)	M1 for a correct expression seen in (c) (or ft their diagram). Correct ans M1A1
(d)	M1 for denominator of 47 or ft their numerator from part (c) and numerator of 38 or their (17 + 8 + 13) or (their 47) – their (2 + 3 + 4). Correct ans M1A1
(e)	M1 for stating at least the required probs.& labelled for a correct test (can ft their diagram) M1 for use of a correct test with B and C Must see product attempted for $P(B\cap C)$ test. A1 for a correct test with all probabilities correct and a correct concluding statement. NB M0M1A0 should be possible but A1 requires both Ms

Question 3

Question Number	Scheme	Marks
a (i)	A hypothesis is a statement made about the value of a population parameter. A hypothesis test uses a sample or an experiment to determine whether or not to reject the hypothesis	A1
(ii)	The critical value is the first value to fall inside of the critical region	A1
(iii)	The acceptance region is the region where we accept the null hypothesis	A1
b	$H_0: p = 0.2 \qquad H_1: p \neq 0.2$	B1
	If H_0 is true $X \sim B(20, 0.2)$	
	Let c_1 and c_2 be the two critical values so $P(X \leq c_1) \leq 0.05$ and $P(X \geq c_2) \leq 0.05$	
	For the lower tail:	
	$P(X = 0) = 0.0115 < 0.05$ $P(X \leq 1) = 0.0692 > 0.05$	M1
	So $c_1 = 0$	
	For the upper tail:	
	$P(X \geq 7) = 1 - P(X \leq 6) = 1 - 0.9133 = 0.0978 > 0.05$ $P(X \geq 8) = 1 - P(X \leq 7) = 1 - 0.9679 = 0.0321 < 0.05$	M1
	So $c_2 = 8$	
	So the critical region is $X = 0$ and $X \geq 8$	A1 A1
c	Actual significance level $= 0.0115 + 0.0321 = 0.0436 = 4.36\%$	B1
d	As 7 does not lie in the critical region, H_o is not rejected. Therefore, the probability of a person buying particular product has not changed	A1 A1

Question 4

Q4	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3a	The data seems to follow an exponential distribution.	**B1**	2.4	6th Understand exponential models in bivariate data.
		(1)		
3b	$r = 0.9735$ is close to 1	**B1**	2.2a	2nd Know and understand the language of correlation and regression.
	which gives a strong positive correlation.	**B1**	2.4	
		(2)		
3c	Model is a good fit with a reason. For example, Very strong positive linear correlation between t and $\log_{10} p$. The **transformed data points** lie close (enough) to a straight line.	**B2**	3.2a	6th Understand exponential models in bivariate data.
		(2)		
				(5 marks)

Notes

4c

B0 for just stating the model is a good fit with no reason.

Question 5

Q5	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4a	$H_0 : \rho = 0$, $H_1 : \rho < 0$ Critical value = −0.6319 −0.6319 < −0.136 no evidence to reject H_0 (test statistic not in critical region) There is insufficient evidence to suggest that the daily total rainfall and amount of daily maximum relative humidity are negatively correlated.	**B1** **M1** **A1**	2.5 1.1a 2.2b	6th Carry out a hypothesis test for zero correlation.
		(3)		
4b	Sensible explanation. For example, correlation shows there is no (or extremely weak) linear realtionship between the two variables.	**B1**	1.2	7th Interpret the results of a hypothesis test for zero correlation.
	For example, there could be a non-linear relationship between the two variables.	**B1**	3.5b	
		(2)		
				(5 marks)
Notes				