A level Statistics Paper 1 MARK SCHEME

Question 1

Question Number	Scheme	Marks
(a)	70 – 80 group - width **0.5** (cm)	B1
	1.5 cm^2 is 10 customers or 3.75cm^2 is 25 customers or $0.5c = 3.75$ or $\frac{2.5}{\frac{1}{3}}$	M1
	70 – 80 group - height **7.5** (cm)	A1
		(3)
(b)	Median $= (70) + \frac{13.5}{25} \times 10$ allow $(n+1) = (70) + \frac{14}{25} \times 10$	M1
	$=$ **75.4** (or if using $(n+1)$ allow 75.6)	A1
		(2)
(c)	$\left[\text{Mean} = \frac{6460}{85}\right] =$ **76**	B1
	$\sigma = \sqrt{\frac{529400}{85} - 76^2}$	M1
	$= 21.2658\ldots\ldots$ $(s = 21.3920)$ **awrt 21.3**	A1
		(3)

	Notes
(a)	B1 for 0.5
	M1 for one of the given statements or any method where "their width" × "their height" = 3.75 Correct height scores M1A1 independent of width so B0M1A1 is possible.
(b)	M1 for a correct fraction: $+\frac{k}{25} \times 10$ where $k = 13.5$ or 14 for $(n+1)$ case.
	NB may work down so look out for (80) $-\frac{11.5}{25} \times 10$ etc **Beware:** $69.5 + \frac{13.5}{25} \times 11 = 75.44$ (but M0)
(c)	M1 for a correct expression with square root, ft their mean
	A1 for awrt 21.3 or, if clearly using s allow awrt 21.4. Must be evaluated...no surds.

Question 2

Question Number	Scheme	Marks
	mean $= \frac{60.8+20}{1.4}$ or $60.8 = 1.4x - 20$ (o.e.)	M1
	$= 57.7142\ldots$ awrt **57.7**	A1
	standard deviation $= \frac{6.60}{1.4}$ or $6.60 = 1.4x$	M1
	$= 4.7142\ldots$ awrt **4.71**	A1
		(4)
		Total 4
	Notes	
	1st M1 sub. 60.8 for y into a correct equation. Allow use of x or any other letter or expression for mean	
	1st A1 for awrt 57.7 or $\frac{404}{7}$ (o.e.). Correct answer only is 2/2	
	2nd M1 sub. 6.60 or 6.6 for y and ignoring the 20 Allow use of x or any other letter or expression for st. dev. $6.60^2 = 1.4^2x^2$ is M0 until we see them take a square root.	
	2nd A1 for awrt 4.71 or $\frac{33}{7}$ (o.e.). Correct answer only is 2/2	

Question 3

Question Number	Scheme	Marks
(a)	$[\,P(A)=1-0.18-0.22\,]$ = **0.6** (or exact equivalent)	B1 **(1)**
(b)	$P(A\cup B)=$"0.6"$+0.22$ = **0.82** (or exact equivalent)	B1ft **(1)**
(c)	$x=P(A\cap B)$ | Use $P(B)P(A'\mid B)=P(A'\cap B)$ | **Establish** independence before or after 1st M1 and score marks for (d) (RH ver)	M1
	$\frac{x}{x+0.22}=0.6$ | $P(B)\times[1-0.6]=0.22$ | **Find** $P(B)$	
	$x=0.6x+0.132$ | Use $P(A\cap B)=P(A\mid B)P(B)$ | Use $P(B)P(A)=P(A\cap B)$	dM1
	$0.4x=0.132$ | $P(A\cap B)=0.6\times0.55$ | $P(A\cap B)=0.6\times0.55$	
	$x=$ **0.33** (or exact equivalent)	A1cso **(3)**
(d)	$P(B)=0.55$	
	$P(B)\times P(A)=0.55\times0.6$ $=0.33$ | **or** stating $P(A)=P(A\mid B)$ [= 0.6]	M1
	$P(B)\times P(A)=P(A\cap B)$ therefore (statistically) independent | **or** $P(A)=P(A\mid B)$ therefore (statistically) independent	A1cso **(2)**
		Total 7

Notes

(b) B1ft for their (a) + 0.22 or 1 − $P(A'\cap B')$ Do not ft their (a) if it is > 0.78

NB 3 versions for (c). Check carefully that Ms are genuinely scored.

Look out for assuming independence and if you see P(B) = 0.55 check it is derived properly

(c) 1st M1 for a correct equation for x e.g. $\frac{x}{x+0.22}=0.6$ or a correctly derived equation for $P(B)$

2nd dM1 for solving to get in form $kx = L$ or correct use of $P(B)$ to find $P(A\cap B)$ [2nd or 3rd ver] or $P(A\cap B)=P(B)-0.22$

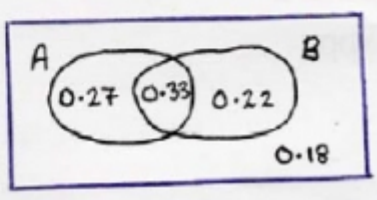
A1cso for 0.33 Dep. on both Ms and no incorrect working seen.

(d) M1 for finding $P(B)\times P(A)=0.33$ (values needed) or stating $P(A)=P(A|B)$ (= 0.6 not needed)

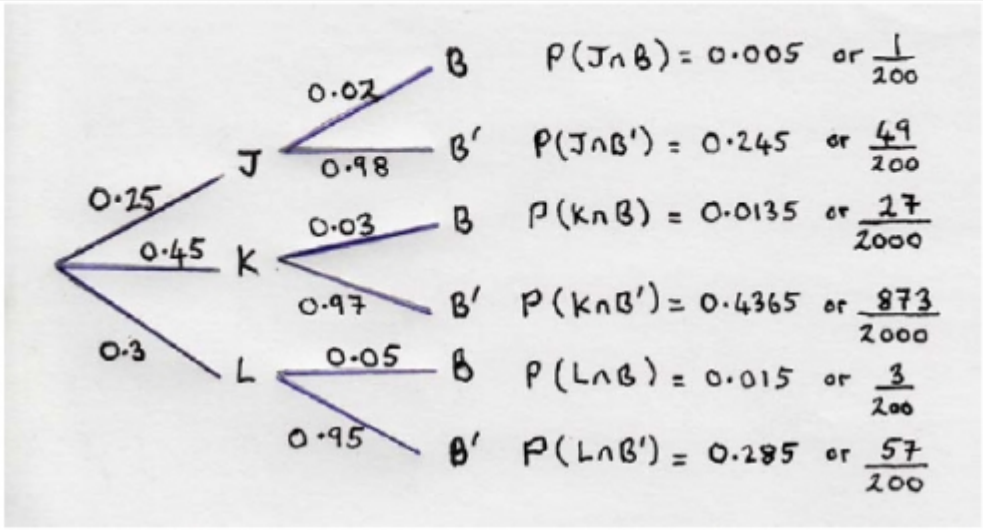
A1cso for a correct statement: $P(B)\times P(A)=P(A\cap B)$ or $P(A)=P(A|B)$ and stating independent

NB The M1 in (d) using $P(A\cap B)$ requires $P(B)=0.55$
There is no ft of an incorrect $P(B)$
Full marks in (d) is OK even if 0/3 in (c)

{This Venn diagram may be helpful.}



Question 4

Question Number	Scheme	Marks
(a)		M1 A1 (2)
(b)	0.25×0.98, $= \mathbf{0.245}$ (or exact equiv. e.g. $\frac{49}{200}$)	M1A1 (2)
(c)	$0.25\times0.02+0.45\times0.03+0.3\times0.05$, $= \mathbf{0.0335}$ (or exact equiv. e.g. $\frac{67}{2000}$)	M1A1 (2)
(d)	$[\mathrm{P}(J\cup L\mid B)]=\frac{0.25\times0.02+0.3\times0.05}{0.0335}$ or $\frac{0.0335-0.45\times0.03}{0.0335}$ $=0.5970...$ awrt **0.597** (or $\frac{40}{67}$ or exact equiv.)	M1A1ft A1 (3)
	Notes	**Total 9**
	Allow fractions or percentages throughout this question	
(a)	Allow 3+6 tree diagram with the 6 correct "end" probs and labels to get 2/2 (1st, 3rd, 5th gets M1) M1 for (3+6) tree drawn with 0.25, 0.45, 0.02, 0.03, 0.05 on correct branches A1 for 0.3, 0.98, 0.97, 0.95 on the correct branches and labels, condone missing B's **Correct answer only scores full marks for parts (b), (c) and (d)** **When using "their probability p" for M1 and A1ft they must have $0<p<1$**	
(b)	M1 for $0.25\times$ 'their 0.98' o.e.	
(c)	M1 for $0.25\times$ their $0.02+0.45\times$ their $0.03+$ their $0.3\times$ their 0.05 Condone 1 transcription error. Or $1-(0.25\times$ their $0.98+0.45\times$ their $0.97+$ their $0.3\times$ their $0.95)$	
(d)	M1 for use of conditional probability with their (c) as denominator. Also exactly 2 products on num' and at least one correct (or correct ft) or their (c) – one of the products from their (c). Ignore an incorrect expression inside their probability statement A1ft for $\frac{0.25\times\text{their }0.02+\text{their }0.3\times\text{their }0.05}{\text{their(c)}}$ or $\frac{\text{their (c)}-0.45\times\text{their }0.03}{\text{their (c)}}$ or $\frac{0.02}{\text{their (c)}}$ A1 awrt 0.597 or exact fraction e.g. $\frac{40}{67}$	

Question 5

Q5	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
a	$\log_{10} c = 1.89 - 0.0131t$ $c = 10^{1.89-0.0131t}$ $c = 77.6 \times 0.970^t$ (3 s.f.)	**M1** **M1** **A1**	1.1a 1.1b 1.1b	6th Understand exponential models in bivariate data.
		(3)		
b	*b* is the proportional rate at which the temperature changes per minute.	**A1**	3.2a	6th Understand exponential models in bivariate data.
		(1)		
c	Extrapolation/out of the range of the data.	**A1**	2.4	4th Understand the concepts of interpolation and extrapolation.
		(1)		
				(5 marks)
Notes				

Question 6

Q6	Scheme	Marks
a	$r = 0.9940$ (4 d.p)	B1A1
	B1 for 0.99… seen A1 for $r = 0.9940$	(2)
b	Linear association between amount of sunshine and ice cream sales	B1
		(1)
c	It requires extropolation and hence it may be unreliable.	B1
		(1)
d	$H_0 : \rho = 0$, $H_1 : \rho > 0$ Critical value = 0.7067 0.9940 > 0.7067 Reject H_0 There is evidence at the 2.5% level of significance to reject H_0 and to support the alternative hypothesis that the amount of sunshine and ice cream sales are positively correlated.	B1 M1 A1
		(3)

Question 7

Q7	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
a	$P(X \leqslant 1) = 0.0076$ and $P(X \leqslant 2) = 0.0355$	M1	1.1b	5th Find critical values and critical regions for a binomial distribution.
	$P(X \geqslant 10) = 1 - 0.9520 = 0.0480$ and $P(X \geqslant 11) = 1 - 0.9829 = 0.0171$	A1	1.1b	
	Critical region is $X \leqslant 1 \cup 11 \leqslant X (\leqslant 20)$	A1	1.1b	
		(3)		
b	Significance level = 0.0076 + 0.0171 = 0.0247 or 2.47%	B1	1.1b	6th Calculate actual significance levels for a binomial distribution test.
		(1)		
c	Not in critical region therefore insufficient evidence to reject H_0.	B1	2.2b	6th

	There is insufficient evidence at the 5% level to suggest that the value of p is not 0.3.	**B1**	3.2a	Interpret the results of a binomial distribution test in context.
		(2)		
				(**6 marks**)

Notes

c

Conclusion must contain context and non-assertive for first B1.

Question 8

Question Number	Scheme	Marks
(a)	$z = \pm 3.2905$	B1
	$\sigma = \frac{30}{3.2905}$	M1
	$\sigma = 9.117$ **	A1cso
		(3)
(b)	$H_0: \mu = 1000$ $H_1: \mu < 1000$	B1
	mean weight = 999.54	B1
	$z = \frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}} = \frac{(999.54-1000)}{\frac{9.117}{\sqrt{10}}} = -0.160$ or $\frac{c-1000}{\sqrt{83.12/10}} = -2.3263 \therefore$ CR $c < 993.29$	M1A1
	1% critical value = -2.3263	B1
	$-2.3263 < -0.160$	
	Accept H_0 / not in critical region	dM1
	There is no evidence that that the machine is delivering packets of mean weight less than 1 kg	A1ft
		(7)
		Total 10