Question	Scheme	Marks	AOs
1(a)	Width = $0.4\times\ 5 = \mathbf{2}$ (cm)	B1	3.1a
	Area = 12 cm^2 Frequency = 15 so 1 $cm^2 = \frac{5}{4}$ packet o.e	M1	1.1b
	Frequency of 9 corresponds to area of 7.2 Height = $7.2 \div 2 = 3.6$ (cm)	A1	1.1b
		(3)	
(b)	$[Q_2 =]\ (248+)\ \frac{22}{35}\times 4$ **or** (use of $(n+1)$) $(248+)\frac{22.5}{35}\times 4$	M1	1.1a
	= awrt 250.5 (g) or 250.6	A1	1.1b
		(2)	
(c)	Mean = awrt 250.4 (g)	B1	1.1b
	$[\sigma_x =]\ \sqrt{\frac{5644171.75}{90}-\left(\frac{22535.5}{90}\right)^2} = \sqrt{15.64...}$	M1	1.1b
	= awrt 4.0 (g)	A1	1.1b
	Accept $\left(s_x = \sqrt{\frac{5644171.75-90\left(\frac{22535.5}{90}\right)^2}{89}} = 3.977...\right)$	**(3)**	
(d)	$H_0 : \mu = 250$ $H_1 : \mu > 250$	B1	2.5
	$\bar{X} \sim N\left(250, \frac{4^2}{90}\right)$ and $\bar{X} > 250.4$	M1	3.3
	$P(\bar{X} > 250.4) = 0.171\ldots$	A1	3.4
	$0.171 > 0.05$ or $z = 0.9486\ldots < 1.6449$	A1	1.1b
	There is insufficient evidence that the mean weight of coffee is greater than 250 g, or there is no evidence to support the sellers claim.	A1	2.2b
		(5)	
(e)	It is consistent as (the estimate of) the mean is close to (the estimate of) the median which is true for the normal distribution.	B1ft	3.5b
		(1)	
			(14 marks)

Notes:
(a) B1: for correct width **M1:** for clear attempt to relate the area to frequency. May be implied by their height × their width = 7.2 **A1:** for height = 3.6 cm
(b) M1: for $\frac{22}{35}\times 4$ or $\frac{22.5}{35}\times 4$ **A1:** awrt 250.5 or 250.6
(c) B1: awrt 250.4 **M1:** for a correct expression for σ or s, can ft their mean **A1:** awrt 4.0 (allow s = awrt 4.0)
(d) **B1:** hypotheses stated correctly **M1:** for selecting a correct model, (stated or implied) **A1:** for use of the correct model to find p = awrt 0.171 (allow z = awrt 0.948) **A1:** for a correct calculation, comparison and correct statement **A1:** for a correct conclusion in context mentioning mean weight and 250
(e) B1: evaluating the validity of the model used in (d)

Question	Scheme	Marks	AOs
2(a)	Not suitable with a correct reason eg the points do not lie close to a straight line. there appear to be two populations if *G* and *H* were removed it appears to be a negative correlation	B1	1.2
		(1)	
(b)	$H_0 : \rho = 0 \quad H_1 : \rho > 0$	B1	2.5
	Critical value 0.5509	M1	1.1a
	Reject H_0		
	There is evidence that pmcc is greater than zero	A1	2.2b
		(3)	
(c)	Beijing and Jacksonville	B1	2.2a
		(1)	
(d)	Beijing and Jacksonville are the closest to the equator	B1	2.4
		(1)	
(e)	Use data from one place.	B1	2.4
		(1)	
			(7 marks)

Notes:

(a) B1: for a correct statement using the data in the table

(b) B1: for both hypotheses in terms of ρ

M1: for selecting a suitable critical value compatible with their H_1

A1: for a correct conclusion stated

(c) B1: both Beijing and Jacksonville – they do not need to be attached to G and H correctly.

(d) B1: for the idea they are near the equator dependent only Beijing or Jacksonville being given in part(c)

Question	Scheme	Marks	AOs
3(a)	[A = no. of bulbs that grow into plants with blue flowers,] $A \sim B(40, 0.36)$	M1	3.3
	$p = P(A \geq 21) = 0.0240$	A1	1.1b
	C = no. of bags with more than 20 bulbs that grow into blue flowers, $C \sim B(5, p)$	M1	3.3
	So $P(C \leq 1) = 0.9945\ldots$ awrt 0.995	A1	1.1b
		(4)	
(b)	[$T \sim$ number of bulbs that grow into blue flowers] $T \sim B(n, 0.36)$		
	T can be approximated by $N(0.36n, 0.2304n)$	B1	3.4
	$P\left(Z < \dfrac{244.5 - 0.36n}{\sqrt{0.2304n}}\right) = 0.9479$	M1	1.1b
	$\dfrac{244.5 - 0.36n}{\sqrt{0.2304n}} = 1.625$ or $\dfrac{244.5 - 0.36x^2}{0.48x} = 1.625$	M1 A1	3.4 1.1b
	$0.36n + 0.78\sqrt{n} - 244.5 = 0$	M1	1.1b
	$n = 625$	A1cso	1.1b
		(6)	
			(10 marks)

Notes:

(a) **M1:** for selecting an appropriate model for A

A1: for a correct value of the parameter p for C

M1: for selecting an appropriate model for C

A1: for awrt 0.995

(b) **B1:** for correct normal distribution

M1: for correct use of continuity correction equal to a z value where $|z| > 1$

M1: for standardisation with their μ and σ

A1: for a correct equation

M1: using a correct method to solve their 3-term quadratic

A1: 625 on its own cso

Question	Scheme	Marks	AOs
4(a)	$\mathrm{P}(S \cap D') = 0$	B1	1.1b
		(1)	
(b)	$\mathrm{P}(C \mid S \cap D) = \frac{0.27}{0.6} = \frac{9}{20} = 0.45$	M1	3.1b
	$\therefore 80 \times "0.45"$	M1	1.1b
	$=36$	A1	1.1b
		(3)	
(c)	$[\mathrm{P}(C) \times \mathrm{P}(S) = \mathrm{P}(C \cap S)]$		
	$\mathrm{P}(S) = 0.6$, $\mathrm{P}(C) = 0.27 + v + u$, $\mathrm{P}(S \cap C) = 0.27$	M1	3.1a
	$0.6 \times (0.27 + u + v) = 0.27$ or $u + v = 0.18$ o.e	A1	1.1b
	$\left[\mathrm{P}(D \mid C) = \frac{\mathrm{P}(D \cap C)}{\mathrm{P}(C)}\right]$ $\mathrm{P}(D \cap C) = 0.27 + v$	M1	3.1a
	$\frac{14}{15} = \frac{0.27 + v}{0.27 + v + u}$ or $14u - v = 0.27$ o.e	A1	1.1b
	$15u = 0.45$	M1dd	1.1b
	$u = 0.03$ $v = 0.15$	A1	1.1b
	$w = 0.22$	A1ft	1.1b
		(7)	
			(11 marks)

Notes:

(a) B1: correct answer only

(b) M1: for a correct ratio of probabilities formula with at least one correct value and multiplying by 80

A1: a correct answer

(c) M1: for translating the problem and realising the equation $\mathrm{P}(C) \times \mathrm{P}(S) = P(C \cap S)$ needs to be used with at least 2 parts correct.

A1: a correct equation

M1: for a correct probability formula with $\mathrm{P}(D \cap C) = 0.27 + v$

A1: a second correct equation

M1dd: dependent on the previous 2 method marks being awarded. Solving the two simultaneous equations by eliminating one variable. May be implied by either *u* or *v* correct

A1: *u* correct

A1: *v* correct

A1ft: w = 0.22, ft *their* u, v provided that $u + v + w < 0.4$

Question	Scheme	Marks	AOs
5(a)	$P(L_X > 160) = P\left(Z > \frac{160-150}{25}\right)$		
	$= P(Z > 0.4)$		
	$= 1 - 0.6554$		
	= awrt 0.345 0.34457…..	B1	1.1b
	Expected number = $12 \times$"0.345"	M1	1.1b
	= 4.13 (allow 4.14)	A1	1.1b
		(3)	
(b)	$P(L_Y < 180) = 0.841621…..$	B1	3.4
	$\frac{180-160}{\sigma} = 0.8416$	M1	1.1b
	σ = awrt 23.8	A1	1.1b
		(3)	
(c)	The standard deviations for two companies are close but the mean for company *Y* is higher	M1	2.4
	therefore choose company *Y*	A1	2.2b
		(2)	
			(8 marks)

Notes:

(a) B1: awrt 0.345
M1: for multiplying their probability by 12
A1: 4.13 (allow 4.14)

(b) B1: for use of the correct model to find the correct value of *z* awrt 0.842
M1: for standardising = to a *Z* value $0.5 < Z < 1$
A1: awrt 23.8

(c) M1: for a correct reason following their part(b)
A1: for making an inference that follows their part(b)