



National
Qualifications
2026

2026 Statistics

Advanced Higher Paper 2

Question Paper Finalised Marking Instructions

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General marking principles for Advanced Higher Statistics

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

The marking instructions for each question are generally in two sections:

- *generic scheme – this indicates why each mark is awarded*
- *illustrative scheme – this covers methods which are commonly seen throughout the marking*

In general, you should use the illustrative scheme. Only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.

- Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.
- If you are uncertain how to assess a specific candidate response because it is not covered by the general marking principles or the detailed marking instructions, you must seek guidance from your team leader.
- One mark is available for each •. There are no half marks.
- If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.
- Only award full marks where the solution contains appropriate working. A correct answer with no working receives no mark, unless specifically mentioned in the marking instructions.
- Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.
- If an error is trivial, casual or insignificant, for example $6 \times 6 = 12$, candidates lose the opportunity to gain a mark, except for instances such as the second example in point (h) below.
- If a candidate makes a transcription error (question paper to script or within script), they lose the opportunity to gain the next process mark, for example

This is a transcription error and so the mark is not awarded.

This is no longer a solution of a quadratic equation, so the mark is not awarded.

$$x^2 + 5x + 7 = 9x + 4$$

$$x - 4x + 3 = 0$$

$$x = 1$$

The following example is an exception to the above

This error is not treated as a transcription error, as the candidate deals with the intended quadratic equation. The candidate has been given the benefit of the doubt and all marks awarded.

$$x^2 + 5x + 7 = 9x + 4$$

$$x - 4x + 3 = 0$$

$$(x - 3)(x - 1) = 0$$

$$x = 1 \text{ or } 3$$

(i) **Horizontal/vertical marking**

If a question results in two pairs of solutions, apply the following technique, but only if indicated in the detailed marking instructions for the question.

Example:

$$\begin{array}{cc} \bullet^5 & \bullet^6 \\ \bullet^5 & x = 2 \quad x = -4 \\ \bullet^6 & y = 5 \quad y = -7 \end{array}$$

Horizontal: $\bullet^5 x = 2$ and $x = -4$ Vertical: $\bullet^5 x = 2$ and $y = 5$
 $\bullet^6 y = 5$ and $y = -7$ $\bullet^6 x = -4$ and $y = -7$

You must choose whichever method benefits the candidate, **not** a combination of both.

(j) In final answers, candidates should simplify numerical values as far as possible unless specifically mentioned in the detailed marking instruction. For example

$$\frac{15}{12} \text{ must be simplified to } \frac{5}{4} \text{ or } 1\frac{1}{4} \quad \frac{43}{1} \text{ must be simplified to } 43$$

$$\frac{15}{0.3} \text{ must be simplified to } 50 \quad \frac{4\cancel{5}}{3} \text{ must be simplified to } \frac{4}{15}$$

$$\sqrt{64} \text{ must be simplified to } 8^*$$

*The square root of perfect squares up to and including 144 must be known.

(k) Do not penalise candidates for any of the following, unless specifically mentioned in the detailed marking instructions:

- working subsequent to a correct answer
- correct working in the wrong part of a question
- legitimate variations in numerical answers/algebraic expressions, for example angles in degrees rounded to nearest degree
- omission of units
- bad form (bad form only becomes bad form if subsequent working is correct), for example

$$(x^3 + 2x^2 + 3x + 2)(2x + 1) \text{ written as}$$

$$(x^3 + 2x^2 + 3x + 2) \times 2x + 1$$

$$= 2x^4 + 5x^3 + 8x^2 + 7x + 2$$

gains full credit

- repeated error within a question, but not between questions or papers

(l) In any 'Show that...' question, where candidates have to arrive at a required result, the last mark is not awarded as a follow-through from a previous error, unless specified in the detailed marking instructions.

(m) You must check all working carefully, even where a fundamental misunderstanding is apparent early in a candidate's response. You may still be able to award marks later in the question so you must refer continually to the marking instructions. The appearance of the correct answer does not necessarily indicate that you can award all the available marks to a candidate.

(n) You should mark legible scored-out working that has not been replaced. However, if the scored-out working has been replaced, you must only mark the replacement working.

- (o) If candidates make multiple attempts using the same strategy and do not identify their final answer, mark all attempts and award the lowest mark. If candidates try different valid strategies, apply the above rule to attempts within each strategy and then award the highest mark.

For example:

Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Marking Instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.	(a)		•¹ calculate at least one fence •² appropriate statement	•¹ upper fence = 23.55 lower fence = 16.75 •² yes, possible outliers exist as maximum of 24.1 > 23.55 minimum of 16.3 < 16.75	2
Notes: 1. For • ¹ , calculation of one fence value is sufficient. 2. For • ² , appropriate statement for either maximum or minimum value is sufficient.					
Commonly Observed Responses:					
	(b)		•³ state hypotheses •⁴ calculate test statistic •⁵ state critical value •⁶ deal with H_0 •⁷ appropriate conclusion	•³ $H_0: \mu_{\text{white}} = \mu_{\text{asian}}$ $H_1: \mu_{\text{white}} \neq \mu_{\text{asian}}$ •⁴ $z = \frac{20.2 - 19.8}{\sqrt{\frac{1.38^2}{216} + \frac{1.15^2}{87}}} = 2.581$ •⁵ $z_{0.9995} = 3.29$ •⁶ as $2.581 < 3.29$ we do not reject H_0 •⁷ insufficient evidence (at the 0.1% level) to suggest that there is a difference in the mean hand spans between White and Asian pianists	5
Notes: 1. For • ³ , do not accept $H_0: \text{mean}_{\text{white}} = \text{mean}_{\text{asian}}$, etc, as hypotheses must refer to population means. 2. For • ⁵ , also accept $p\text{-value} = 0.009851$. 3. For • ⁶ , also accept 'as $p\text{-value} > 0.001$, we do not reject H_0 '. 4. For • ⁶ , do not accept comparison of two values that have different signs. 5. For • ⁶ , if the calculated test statistic, • ⁴ $z = 2.58$, and the • ⁵ critical value is incorrectly stated as 2.58, then only award • ⁶ for rejecting H_0 . 6. For • ⁷ , conclusion must be phrased in terms of H_1 . 7. For • ⁷ , do not accept conclusions that are too definite. Phrasing must include 'evidence to conclude...', or 'evidence to suggest...', or similar.					
Commonly Observed Responses:					
Candidate A $\left. \begin{array}{l} H_0 : \mu_{\text{difference}} = 0 \\ H_1 : \mu_{\text{difference}} \neq 0 \end{array} \right\} \begin{array}{l} \bullet^3 \text{ not available.} \\ \bullet^7 \text{ can only be awarded if conclusion is phrased in terms of 'mean difference'.} \end{array}$					

Question			Generic scheme	Illustrative scheme	Max mark
1.	(c)		• ⁸ appropriate assumption	• ⁸ samples are representative of the populations	1

Notes:

- For •⁸, also accept:
‘samples need to be randomly selected’.
‘independent handspans’.
‘independent observations’.
responses that convey that ‘everything is independent to everything else’.
- For •⁸, do not accept:
‘independent populations’.
‘independent samples’.
responses that only refer to independence between samples, or independence within each sample.

Commonly Observed Responses:

Candidate A provides more than one assumption for part (c).

Treat each assumption as using the same strategy, mark each possible assumption on its own and then award the lowest mark from across all assumptions:

Number of assumptions	Number correct	Number incorrect	Marks Awarded
2	0	2	0
2	1	1	0
2	2	0	1
3	0	3	0
3	1	2	0
3	2	1	0

Question			Generic scheme	Illustrative scheme	Max mark
2.	(a)	(i)	•¹ calculate b •² calculate equation	•¹ $b = -2.57$ •² $y = 79.4 - 2.57x$	2
Notes:					
Commonly Observed Responses:					
		(ii)	•³ calculate fitted value •⁴ calculate residual	•³ $\hat{y} = 53.7$ •⁴ $58 - 53.7 = 4.3$	2
Notes: 1. For • ³ , do not penalise the omission of the hat. 2. For • ³ , refer to the calculated equation in part (a)(i) for the possible award of follow through marks in part (a)(ii).					
Commonly Observed Responses:					
	(b)		•⁵ valid reason	•⁵ the equation in (a) is for regression of y on x whereas this would require regression of x on y	1
Notes:					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
3.	(a)		• ¹ correct distribution	• ¹ $X \sim U(n)$	1
Notes: 1. For • ¹ , do not accept ‘uniform’ on its own. Parameter must also be stated.					
Commonly Observed Responses:					
	(b)		• ² equate and substitute • ³ calculate value	• ² $\frac{n^2 - 1}{12} = 2552$ • ³ $n^2 = 30625 \Rightarrow n = 175$ (as $n > 0$)	2
Notes: Commonly Observed Responses: Candidate A who stated in (a) that $X \sim B\left(n, \frac{1}{n}\right)$. Mark • ² available for $2552 = n \times \frac{1}{n} \times \left(1 - \frac{1}{n}\right)$. Mark • ³ not available. Candidate B who stated in (a) that $X \sim U(1, n)$. Mark • ² available for $\frac{(n-1)^2}{12} = 2552$. Mark • ³ available for $(n-1)^2 = 30624 \Rightarrow n = 175.997 \approx 176$. Candidate C who did not state in (a) that $X \sim U(1, n)$. Mark • ² not available for $\frac{(n-1)^2}{12} = 2552$. Mark • ³ available for $(n-1)^2 = 30624 \Rightarrow n = 175.997 \approx 176$.					
	(c)		• ⁴ appropriate strategy • ⁵ calculate value	• ⁴ $V(Y) = V(20X) = 20^2 \times V(X)$ • ⁵ (£) 1010.35	2
Notes: 1. For • ⁵ , do not penalise rounding.					
Commonly Observed Responses: Candidate A $\left. \begin{array}{l} V(Y) = V(20X) = 20 \times V(X) \\ SD(Y) = (£)225.92 \end{array} \right\} \text{award } \bullet^4 \times \bullet^5 \checkmark.$					

Question			Generic scheme	Illustrative scheme	Max mark
4.			•¹ state hypotheses •² ranks, with tied values •³ calculate test statistic •⁴ critical value •⁵ deal with H_0 •⁶ appropriate conclusion	•¹ $H_0: \eta_{\text{difference}} = 0$ $H_1: \eta_{\text{difference}} > 0$ •² ranks: 1.5 7 3.5 6 5 1.5 3.5 •³ $W = \min(6.5, 21.5) = 6.5$ •⁴ 5% one-tail critical value = 3 •⁵ as $6.5 > 3$, we do not reject H_0 •⁶ insufficient evidence (at the 5% level) to suggest that the population median difference is greater than zero (which means that we don't have, on average, the number of deliberate fires being more than 6 times the number of accidental fires)	6

Notes:

1. For •², see the table below for the full calculations.

	Mon	Tue	Wed	Thu	Fri	Sat	Sun
6x Accidental total	30	54	42	48	24	48	54
Deliberate total	38	30	32	30	36	40	44
Difference	8	-24	-10	-18	12	-8	-10
Rank	1.5	7	3.5	6	5	1.5	3.5

2. For •², also accept ranks of 1.5 7 3 6 5 1.5 4 or 1.5 7 4 6 5 1.5 3 (the tied ranks of 1.5 are only required for the differences of ± 8).

3. For •⁶, conclusion must include reference to 'median' or 'average'.

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
5.	(a)		•¹ appropriate strategy •² substitute and calculate UCL and LCL to 4 decimal places •³ appropriate comment	•¹ $p \pm 3 \times \sqrt{\frac{p \times q}{n}}$ •² $\begin{cases} 0.15 \pm 3 \times \sqrt{\frac{0.15 \times 0.85}{50}} \\ = 0.3015, -0.0015 \end{cases}$ •³ lower control limit of a p-chart cannot be negative	3
Notes: 1. Mark • ¹ can be implied from mark • ² . 2. For • ³ , also accept: ‘proportions cannot be negative’. ‘proportions must be between 0 and 1 inclusive’.					
Commonly Observed Responses: Candidate A Uses the formula for an $\bar{x}$ -bar control chart. • ¹ not available. • ³ not available.					
	(b)		•⁴ appropriate feature •⁵ appropriate reason	•⁴ 8 consecutive points on the same side of the centre line •⁵ sample proportions of rejection are lower (than the expected 15% rate)	2
Notes: 1. For • ⁴ , also accept mention of 9 consecutive points. 2. For • ⁴ , also accept reference to ‘target line’ or ‘expected proportion line’. 3. For • ⁴ , do not accept ‘8 points between week 8 and week 16’ (as omitted the word ‘consecutive’). 4. For • ⁵ , also accept ‘fewer strawberries were rejected’.					
Commonly Observed Responses:					
	(c)		•⁶ state condition with substituted value •⁷ calculate valid sample size	•⁶ $\begin{cases} np > 5 \\ n \times 0.08 > 5 \\ n > 62.5 \end{cases}$ •⁷ $n = 63$	2
Notes: 1. The condition $nq > 5$ does not need to be evaluated. 2. For • ⁶ , the mark is for $n \times 0.08 > 5$, with a value for p substituted in. 3. For • ⁷ , the value must be an integer that has been rounded up.					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
6.	(a)		• ¹ appropriate reason	• ¹ eg to view the shape of the distribution	1

Notes:

- For •¹, also accept:
‘to view any possible outliers’.
‘to see whether the masses/portions appear to be (less than) 70 grams’.
‘to validate assumptions of normality’.
- For •¹, do not accept:
‘to see if they are normal’.
‘to get a better visual’.
responses referring to control charts.

Commonly Observed Responses:

Candidate A provides more than one reason for part (a).

Treat each reason as using the same strategy, mark each possible reason on its own and then award the lowest mark from across all reasons:

Number of reasons	Number correct	Number incorrect	Marks Awarded
2	0	2	0
2	1	1	0
2	2	0	1
3	0	3	0
3	1	2	0
3	2	1	0

Question			Generic scheme	Illustrative scheme	Max mark
6.	(b)	(i)	• ² appropriate assumption	• ² masses of ice-cream portions are normally distributed	1
Notes: 1. For • ² , do not accept: ‘mean masses are normally distributed’ (as it mentions a distribution parameter). ‘sample is normally distributed’ (as it does not mention the context). responses that refer to ‘independence’ (as this was already covered by the statement in the question that that portions were randomly selected).					
Commonly Observed Responses:					
		(ii)	• ³ appropriate hypotheses • ⁴ correct strategy • ⁵ calculate t • ⁶ appropriate critical value • ⁷ deal with H_0 • ⁸ appropriate conclusion	• ³ $H_0 : \mu = 70$ $H_1 : \mu < 70$ • ⁴ $t = \frac{\bar{x} - \mu}{s / \sqrt{n}}$ • ⁵ $t = \frac{67 - 70}{4 / \sqrt{15}} = -2.9047$ • ⁶ $t_{14,0.99} = 2.624$ • ⁷ $-2.9047 < -2.624$ so we reject H_0 (at the 1% level of significance) • ⁸ there is evidence to suggest that the mean mass of ice-cream served is less than 70 grams	6
Notes: 1. For • ³ , do not accept H_0 : mean = 70, as must refer to population mean. 2. For • ⁵ , only accept test statistics that are negative. 3. For • ⁶ , also accept p -value $P(t_{14} < -2.9047) = 0.0058$. 4. For • ⁷ , also accept ‘0.0058 < 0.01 so we reject H_0 (at the 1% level of significance)’. 5. For • ⁷ , do not accept comparison of two values that have different signs. 6. For • ⁷ , do not accept ‘accept H_1 ’. 7. For • ⁸ , do not accept conclusions that are too definite. Phrasing must include ‘evidence to conclude...’, or ‘evidence to suggest...’, or similar.					
Commonly Observed Responses: Candidate A uses a z -test, instead of a t -test. Marks • ⁴ and • ⁵ not available. Mark • ⁶ available for $z_{0.99} = 2.33$ or a p -value of 0.0018. Marks • ⁷ and • ⁸ available for consistent ‘deal with H_0 ’ and ‘appropriate conclusion’.					

Question			Generic scheme	Illustrative scheme	Max mark
7.	(a)		•¹ identify distribution •² calculate probability	•¹ $X \sim \text{Po}(7.5)$ •² 0.1374	2
Notes: 1. Mark •¹ can be implied from mark •². 2. For •², probability must be given to at least 3 significant figures. 3. For •², the value of 0.1374 is obtained when using $P(X \leq 8) - P(X \leq 7)$ from the tables in the data booklet. Also accepted is 0.1373 from explicit evaluation.					
Commonly Observed Responses: Candidate A $\left. \begin{array}{l} X \sim \text{Po}(2.5) \\ P(X=8)=0.0031 \end{array} \right\} \text{award } \bullet^1 \times \bullet^2 \checkmark.$					
	(b)		•³ appropriate comment	•³ $7.5 < 10$, therefore a normal approximation is not appropriate	1
Notes:					
Commonly Observed Responses:					
	(c)		•⁴ using correct approximate distribution •⁵ standardise •⁶ with continuity correction •⁷ calculate probability •⁸ appropriate comment	•⁴ $Y \approx N(20, 20)$ •⁵•⁶ $P(Y > 15) = P\left(Z > \frac{15 + 0.5 - 20}{\sqrt{20}}\right)$ •⁷ 0.8438 •⁸ 84.38% > 80%, therefore the water heater is viable	5
Notes: 1. Mark •⁴ can be implied from mark •⁵. 2. For •⁷, also accept the exact value of 0.8428 (from a graphic calculator). 3. For •⁸, must include comparison between two percentages.					
Commonly Observed Responses: Candidate A $P\left(Z > \frac{14.5 - 20}{\sqrt{20}}\right) = P(Z > -1.23) = 0.8907 \text{ award } \bullet^5 \checkmark \bullet^6 \times \bullet^7 \checkmark.$ Candidate B $P\left(Z > \frac{15 - 20}{\sqrt{20}}\right) = P(Z > -1.12) = 0.8682 \text{ award } \bullet^5 \checkmark \bullet^6 \times \bullet^7 \checkmark.$					

Question			Generic scheme	Illustrative scheme	Max mark
8.			•¹ appropriate assumption •² appropriate hypotheses •³ correct test statistic •⁴ calculate p •⁵ calculate z •⁶ correct critical value •⁷ deal with H_0 •⁸ appropriate conclusion	•¹ children's offered responses are independent of one another •² $H_0: p_{18} = p_{14}$ $H_1: p_{18} > p_{14}$ •³ $z = \frac{p_{18} - p_{14}}{\sqrt{pq\left(\frac{1}{n_{18}} + \frac{1}{n_{14}}\right)}}$ •⁴ $p = \frac{38+6}{55+31} = \frac{44}{86} = 0.5116$ •⁵ $z = \frac{\frac{38}{55} - \frac{6}{31}}{\sqrt{\frac{44}{86} \times \frac{42}{86} \times \left(\frac{1}{55} + \frac{1}{31}\right)}} = 4.43$ •⁶ $z_{0.99} = 2.33$ •⁷ $4.43 > 2.33$ so reject H_0 (at 1% level of significance) •⁸ evidence to suggest that (in terms of proportions) 18-month-olds are more aware of other people's preferences than 14-month-olds	8

Notes:

1. For •¹, do not accept:
'experiments are independent of each other'.
'each experiment is independent' (as must refer to the children's offered response).
2. For •², do not accept hypotheses that use p with a hat ($\hat{p}$), as they need to refer to a population proportion, and not a sample estimate of the population proportion.
3. For •⁶, also accept $p\text{-value} = 0.0000047$.
4. For •⁷, also accept ' $0.0000047 < 0.01$, so reject H_0 '.
5. Also accept responses where marks •², •⁵, •⁷ and •⁸ are consistent with inequalities and proportions the other way around.

Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
9.			•¹ appropriate assumption •² appropriate strategy of combining random variables •³ correct μ for 24 cans •⁴ correct σ^2 for 24 cans •⁵ calculate μ for 24 drinks •⁶ calculate σ^2 for 24 drinks •⁷ state distribution for 1 drink	•¹ assuming the masses of all cans, drinks and packaging are all independent of each other •² $M = (C_1 + C_2 + \dots + C_{24}) + (D_1 + D_2 + \dots + D_{24}) + P$ •³ $E\left(\sum_{i=1}^{24} C_i\right) = 24 \times 18 = 432$ •⁴ $V\left(\sum_{i=1}^{24} C_i\right) = 24 \times 2 = 48$ •⁵ $\begin{cases} E\left(\sum_{i=1}^{24} D_i\right) = 8884 - 432 - 196 \\ \quad \quad \quad = 8256 \end{cases}$ •⁶ $\begin{cases} V\left(\sum_{i=1}^{24} D_i\right) = 121 - 48 - 1 \\ \quad \quad \quad = 72 \end{cases}$ •⁷ $D_i \sim N\left(\frac{8256}{24}, \frac{72}{24}\right) = N(344, 3)$	7

Notes:

1. For •¹, do not accept assumptions that omit any one of cans, drinks or packaging.
2. For •¹ and •², there should be evidence that more than 48 distinct random variables are being combined and they all need to be independent from each other (to support the valid use of the law of variance for the combining of several random variables).
3. For •², do not accept $M = 24C + 24D + P$.
4. Mark •² is only available when the strategy used has been clearly communicated.

Commonly Observed Responses:

Candidate A writes $V(24C + \dots) = 24V(C) + \dots$.

Mark •² not available.

Mark •⁴ not available.

Candidate B writes $V(24C + \dots) = 24^2V(C) + \dots$.

Mark •² not available.

Mark •⁴ available for 1152.

Mark •⁶ not available.

Mark •⁷ available for $N(\dots, -43)$.

Candidate C uses $V(M) + 24V(C) + V(P) = 24V(D)$, or equivalent.

Mark •⁶ not available.

Mark •⁷ available for $N(\dots, 7.0833)$.

Question			Generic scheme	Illustrative scheme	Max mark
10.			•¹ appropriate description •² appropriate reason	•¹ bias would likely occur ... •² due to the training provider potentially selecting only previous customers who would give a positive review	2
Notes: - For •¹, also accept: ‘a non-representative sample would likely be picked’. - For •¹, do not accept: ‘a non-random sample would likely be picked’. - For •², also accept: ‘training courses might be accepted that were maybe not good enough quality’. ‘as only previous customers who had been successful in the training course rather than those who were not, were put forward’.					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
11.	(a)		•¹ correct distribution •² appropriate strategy •³ calculate probability	•¹ $X \sim B(100, 0.043)$ •² $P(X \geq 1) = 1 - P(X = 0)$ •³ 0.9877	3

Notes:

1. Mark •² can be implied from mark •³.

Commonly Observed Responses:

Candidate A

$P(X = 1) = 0.0554$ award •²✗ •³✓.

Candidate B uses a normal approximation to a binomial.

Mark •¹ available for $X \sim B(100, 0.043)$.

Mark •² not available.

Mark •³ not available.

Candidate C uses a Poisson distribution.

Mark •¹ not available.

Mark •² available for $P(X \geq 1) = 1 - P(X = 0)$.

Mark •³ not available.

Question			Generic scheme	Illustrative scheme	Max mark
11.	(b)	(i)	•⁴ correct probabilities •⁵ calculate probability •⁶ appropriate strategy •⁷ calculate probability	•⁴ $\begin{cases} P(\text{train}) = \frac{90}{190} = 0.4737 \\ P(\text{bus}) = \frac{100}{190} = 0.5263 \end{cases}$ •⁵ $\begin{cases} P(\text{late}) \\ = P(\text{late} \text{train})P(\text{train}) + P(\text{late} \text{bus})P(\text{bus}) \\ = 0.09 \times \frac{90}{190} + 0.043 \times \frac{100}{190} \\ = 0.0653 \end{cases}$ •⁶ $P(\text{train} \text{late}) = \frac{P(\text{late} \text{train})P(\text{train})}{P(\text{late})}$ •⁷ $\frac{0.09 \times 0.4737}{0.0653} = 0.6529$	4
Notes: 1. Only penalise rounding to only 2 significant figures at the first instance of using that rounded probability. 2. For • ⁷ , also accept 0.6532 from using exact fractions.					
Commonly Observed Responses:					
		(ii)	• ⁸ appropriate assumption	•⁸ there is 'equity' between bus and train travel costs/availability/location of departure/etc	1
Notes: 1. For • ⁸ , also accept other phrasings, such as: 'they are not leaving at a time of day when only one form of transport is operating'. 'both buses and trains leave from locations close to each other'. 'both buses and trains are running during the time when the passenger was ready to depart'. responses that are consistent with the probabilities used in (b)(i) mark • ⁴ . 2. For • ⁸ , do not accept: responses that only refer to one mode of transport. responses that mention 'independence'.					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
11.	(c)	(i)	•⁹ correct critical value •¹⁰ correct substitutions •¹¹ calculate interval	•⁹ $\dots \pm 1.96 \times \dots$ •¹⁰ $0.08 \pm \dots \sqrt{\frac{0.08 \times 0.92}{75}}$ •¹¹ (0.0186, 0.1414)	3
Notes:					
Commonly Observed Responses:					
For • ¹⁰ , if fractions used: $\frac{6}{75} \pm \dots \sqrt{\frac{\frac{6}{75} \times \frac{69}{75}}{75}}$.					
		(ii)	•¹² appropriate reason •¹³ appropriate comment	•¹² since the original proportion of 0.09 is within the confidence interval •¹³ there is insufficient evidence that the alterations to the timetable have changed the proportion of late trains	2
Notes:					
1. For • ¹² , response must include reference to 0.09.					
Commonly Observed Responses:					
		(iii)	•¹⁴ state conditions •¹⁵ appropriate comment	•¹⁴ $\begin{cases} np = 75 \times 0.08 = 6 > 5 \\ nq = 75 \times 0.92 = 69 > 5 \end{cases}$ •¹⁵ the binomial distribution is being approximated by the normal	2
Notes:					
1. For • ¹⁴ , also accept ' $np > 5$ and $nq > 5$ ' without either inequality being evaluated.					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
12.	(a)		•¹ correct standardisation •² calculate z-values •³ calculate probability	•¹ $P\left(\frac{\mu - 0.2\sigma - \mu}{\sigma} < Z < \frac{\mu + 0.2\sigma - \mu}{\sigma}\right)$ •² $P(-0.2 < Z < 0.2)$ •³ 0.1585	3
Notes: 1. Mark • ¹ can be implied from mark • ² . 2. For • ² , do not accept approaches that substitute $\mu = 0$ and $\sigma = 1$.					
Commonly Observed Responses:					
	(b)	(i)	•⁴ distribution for $\bar{X}$	•⁴ $N\left(\mu, \frac{\sigma^2}{36}\right)$	1
Notes: For • ⁴ , do not accept inclusion of double tilde ($\approx$), or ‘approximate’.					
Commonly Observed Responses:					
		(ii)	•⁵ correct standardisation •⁶ calculate z-values •⁷ calculate probability	•⁵ $P\left(\frac{\mu - 0.2\sigma - \mu}{\sigma/\sqrt{36}} < Z < \frac{\mu + 0.2\sigma - \mu}{\sigma/\sqrt{36}}\right)$ •⁶ $P(-1.2 < Z < 1.2)$ •⁷ 0.7699	3
Notes: 1. Mark • ⁵ can be inferred from mark • ⁶ . 2. For • ⁶ , do not accept approaches that substitute $\mu = 0$ and $\sigma = 1$.					
Commonly Observed Responses:					

Question			Generic scheme	Illustrative scheme	Max mark
12.	(c)		•⁸ appropriate strategy •⁹ appropriate z-value •¹⁰ equate z-values •¹¹ determine inequality	•⁸ $P\left(Z < \frac{\mu + 0.2\sigma - \mu}{\sigma/\sqrt{n}}\right) \leq 0.9$ •⁹ $z_{0.90} = 1.28$ •¹⁰ $0.2\sqrt{n} \leq 1.28$ •¹¹ $n \leq 40.96$	4
Notes: 1. For • ¹⁰ and • ¹¹ , if a graphic calculator is used to find z , then $0.2\sqrt{n} \leq 1.28155157$ and $n \leq 41.06$. 2. For • ¹¹ , also accept $n \leq 40$.					
Commonly Observed Responses:					

[END OF MARKING INSTRUCTIONS]