Marking Instructions

These marking instructions have been provided to show how SQA would mark this specimen question paper.

SQA ©

General marking principles for Higher Applications of Mathematics

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

For each question, the marking instructions 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.

(a) 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.

(b) 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.

(c) One mark is available for each •. There are no half marks.

(d) 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.

(e) 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.

(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(g) 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) overleaf.

(h) 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:

$$•^5 \qquad •^6$$
$$•^5 \quad x = 2 \quad x = -4$$
$$•^6 \quad y = 5 \quad y = -7$$

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

$\dfrac{15}{12}$ must be simplified to $\dfrac{5}{4}$ or $1\dfrac{1}{4}$ $\dfrac{43}{1}$ must be simplified to 43

$\dfrac{15}{0\cdot3}$ must be simplified to 50 $\dfrac{4/5}{3}$ must be simplified to $\dfrac{4}{15}$

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

*The square root of perfect squares up to and including 100 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

  $(x^3 + 2x^2 + 3x + 2)(2x + 1)$ 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)	(i)	$\bullet^1$ State definition of critical path	$\bullet^1$ eg The sequence of activities that allows the project to be completed in the shortest timescale	1
		(ii)	$\bullet^2$ List activities in order	$\bullet^2$ ABEGH	1
	(b)		$\bullet^3$ Calculate number of days to complete	$\bullet^3$ 17 days	2
			$\bullet^4$ State completion date	$\bullet^4$ 25 February	
	(c)		$\bullet^5$ State maximum number of days	$\bullet^5$ 4 days	1
	(d)		**Option 1**	**Option 1**	2
			$\bullet^6$ State start date	$\bullet^6$ 5 February	
			$\bullet^7$ State valid reason for selected date	$\bullet^7$ Hired in time to avoid any potential delays or issues	
			Option 2	**Option 2**	
			$\bullet^6$ State start date	$\bullet^6$ 6 February	
			$\bullet^7$ State valid reason for selected date	$\bullet^7$ eg Minimise hire costs	
Notes: 1. Accept any other valid reason for $\bullet^7$					
2.			$\bullet^1$ State graph	$\bullet^1$ Graph B	2
			$\bullet^2$ Give appropriate explanation	$\bullet^2$ Explain that the parachutist cannot go upwards at any point during the jump	

Question			Generic scheme	Illustrative scheme	Max mark
3.	(a)	(i)	•[1] Generate comparable boxplots	•[1] (See below)	**1**

Notes:

Boxplot of Pizza Palace and Pentominos

Question			Generic scheme	Illustrative scheme	Max mark
		(ii)	•[2] Comment on boxplots	•[2] eg In general, (median) delivery times similar for both companies	**2**
			•[3] Comment on boxplots	•[3] eg Slightly more variability in Pizza Palace delivery times	
	(b)	(i)	•[4] Generate measure of location	•[4] (See below)	**2**
			•[5] Generate measure of spread	•[5] (See below)	

Notes:

Statistics

Variable	N	Mean	StDev
Pizza Palace	54	25.657	4.918
Pentominos	47	25.096	4.065

Question			Generic scheme	Illustrative scheme	Max mark
		(ii)	•[6] Give appropriate reasons	•[6] eg Delivery times appear to be roughly normally distributed in the boxplots so the appropriate descriptive statistics are the mean and standard deviation to summarise the location and spread	**1**

Question			Generic scheme	Illustrative scheme	Max mark
3.	(c)		•[7] Perform appropriate test	•[7] Two sample t-test	3
			•[8] Interpret result of test	•[8] $p = 0.532$, do not reject the null hypothesis	
			•[9] Relate result to context of question	•[9] We can be 95% sure that the true population difference in mean delivery times is between -1.213 and 2.336 so there is no evidence of a difference in mean delivery times between Pizza Palace and Pentominos	

Notes:

Test

Null hypothesis	H_0: $\mu_1 - \mu_2 = 0$
Alternative hypothesis	H_1: $\mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
0.63	98	0.532

Estimation for Difference

Difference	95% CI for Difference
0.561	(-1.213, 2.336)

	(d)		•[10] Make appropriate comment	•[10] Since there is no evidence of a difference in mean delivery times the choice should be based on preference as both companies equally fast at delivering	1

Question			Generic scheme	Illustrative scheme	Max mark
4.	(a)		•¹ Calculate the amount owed on 31 August 2015	•¹ £5075	4
			•² Calculate the amount owed on 31 August 2017	•² £15,355.25	
			•³ Calculate the amount owed on 30 November 2017	•³ £20,418.56	
			•⁴ Calculate the amount owed 30 June 2018	•⁴ £20,596.67	
	(b)		•⁵ Calculate total monthly payments	•⁵ £686.49	3
			•⁶ Calculate the amount owed on 31 March 2019	•⁶ £20,857.86	
			•⁷ Calculate the amount owed on 1 April 2019	•⁷ £20,171.37	
5.	(a)		•¹ Interpret 'watch **all three**'	•¹ 8 placed where three circles overlap	3
			•² Interpret 'watch **none**'	•² 2 placed 'outside' circles	
			•³ Complete Venn diagram	•³ Remaining values completed correctly	
	(b)		•⁴ Find total number of students	•⁴ 75	2
			•⁵ Determine probability	•⁵ $\dfrac{4}{75}$	
6.	(a)		•¹ State appropriate explanation	•¹ As candle is not a constant width, the wider the candle the longer it takes for height to reduce	1
	(b)		•² Identify height of graph after 3 hours	•² 7 cm	3
			•³ Calculate rate of change	•³ $\dfrac{7}{20}$ or 0.35	
			•⁴ State rate of change with correct units	•⁴ ... cm per hour	
	(c)		•⁵ Identify additional hours	•⁵ 17	3
			•⁶ Calculate extra height	•⁶ 5.95	
			•⁷ Determine height of candle	•⁷ 17.95 (cm)	

Notes:
1. For marks •⁶ and •⁷ accept a rounded value

Question			Generic scheme	Illustrative scheme	Max mark
7.	(a)		•¹ Process tax band	•¹ 0%	**3**
			•² Calculate NI contribution	•² £464.16	
			•³ Calculate annual earnings	•³ £12,035.84	

Notes:
1. For •¹ to be awarded candidates must state that no tax is payable

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		•⁴ Determine number of weeks childcare and travel required	•⁴ 47 **stated or implied by** •⁵	**3**
			•⁵ Calculate cost of childcare and travel	•⁵ £7755	
			•⁶ Calculate net monthly income	•⁶ £356.74	
	(c)		•⁷ Calculate tax	•⁷ Starter rate: £389.12 Basic rate: £1980.40	**4**
			•⁸ Calculate NI contribution	•⁸ £1898.16	
			•⁹ Calculate annual net income	•⁹ £7257.72	
			•¹⁰ Determine monthly increase and state appropriate conclusion	•¹⁰ £248.04 . Yes, he is correct.	
	(d)		•¹¹ State a valid reason	•¹¹ eg More than £60 per week better off	**2**
			•¹² State a valid reason	•¹² eg Promoted post leading to better future prospects	
8.	(a)		•¹ Calculate cost for option C	•¹ £180	**1**
	(b)	(i)	•² Calculate probability of 1-week delay	•² 0.4×0.9 or 0.36	**1**
		(ii)	•³ Calculate probability of 2-week delay	•³ 0.4×0.1 or 0.04	**1**
	(c)		•⁴ Calculate expected cost of 1-week delay	•⁴ £14.40	**3**
			•⁵ Calculate expected cost of 2-week delay	•⁵ £3.20	
			•⁶ Calculate total expected cost	•⁶ £137.60	
	(d)		•⁷ Calculate cost of 5-week hire	•⁷ £150	**2**
			•⁸ Calculate total expected cost with delay	•⁸ £151.60	
	(e)		•⁹ State option with justification	•⁹ Option A, lowest expected cost	**1**

Question			Generic scheme	Illustrative scheme	Max mark
9.	(a)	(i)	•¹ State relationship between variables	•¹ $N = \dfrac{R}{V}$	**1**
		(ii)	•² State number of hours of production per month and calculate the number of litres produced per month. •³ Calculate the volume of one can and hence calculate the total number of cans per month	•² eg 20 days production per month at 8 hours per day, leading to 256 000 litres per month •³ $V = \pi \times 3^2 \times 11.7 \approx 331\,\text{cm}^3$, approximately 774 000 cans required per month	**2**

Notes:
1. At •², allow any reasonable number of hours per month as long as it is explicitly stated. Award follow through marks here and in (iii) even if the number of hours is not stated
2. Do not award •³ for the omission of units. Do not withhold similar marks in subsequent questions
3. Acceptable ranges for hours per month 28 to 744

Question			Generic scheme	Illustrative scheme	Max mark
		(iii)	•⁴ Calculate the amount of steel required per can •⁵ State assumptions and estimate number of sheets required	•⁴ $\approx 277\ \text{cm}^2$ •⁵ eg Some of each sheet will be wasted because the cut-out shapes don't precisely pack into a square. Allowing for 10% wastage, the number of sheets required is approximately 24 000 $\left(774\,000 \times 277\left(\text{cm}^2\right) \div 0.9\left(\text{m}^2\right)\right)$ sheets per month	**2**

Notes:
1. At •⁵, give no credit for calculations that do not allow for wastage. Accept any reasonable figure for wastage. Acceptable range for wastage 5% to 30%

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		•⁶ Identify that number of sheets required is proportional to evaporated milk production •⁷ Estimate the relative tolerance	•⁶ $N = \dfrac{R}{V}$, the number of sheets required is proportional to production rate •⁷ 3000 more sheets per month is roughly 13% of the number of sheets required. Thus the monthly milk production can vary by up to 13% before running out of steel sheets	**2**

Notes:
1. At •⁶, award the mark if proportionality is implicit in the response and/or if the candidate uses the formula from (a) explicitly

Question			Generic scheme	Illustrative scheme	Max mark
10.	(a)		•¹ Complete payments in Euros	•¹ Cells F5–F10	**3**
			•² Correct balance at 1/1/15	•² G6	
			•³ Correct balance at 1/1/19	•³ G10	

Notes:
1. Spreadsheet

	A	B	C	D	E	F	G
1							
2		Banco de Plata Savings					
3							
4		Date	AER	Exchange Rate	Payment In £ (Pounds)	Payment In € (euros)	Balance
5		01 January 2014	4.00%	1.208	£17,000	€ 20,536.00	€ 20,536.00
6		01 January 2015	3.00%	1.303	£2,000	€ 2,606.00	€ 23,963.44
7		01 January 2016	3.50%	1.327	£3,000	€ 3,981.00	€ 28,663.34
8		01 January 2017	3.00%	1.162	£5,000	€ 5,810.00	€ 35,476.56
9		01 January 2018	4.00%	1.132	£2,000	€ 2,264.00	€ 38,804.86
10		01 January 2019	1.50%	1.129	£1,000	€ 1,129.00	€ 41,486.05

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		•⁴ State maximum value	•⁴ €138,286.84	**1**
	(c)		•⁵ Enter interest and correct loan amount.	•⁵ C4 and C5 (2.5%, €96,800.79)	**5**
			•⁶ Calculate initial repayment value	•⁶ C6 (€6209.49)	
			•⁷ Create formulae for interest content and capital content	•⁷ F11 and G11 (see spreadsheet)	
			•⁸ Complete table	•⁸ Table complete to year 20	
			•⁹ Calculate total amount repaid	•⁹ €124,189.87	
	(d)		•¹⁰ Evidence of loan schedule over 25 years with correct interest rate.	•¹⁰ See spreadsheet	**3**
			•¹¹ Complete loan schedule years 6–25	•¹¹ See spreadsheet	
			•¹² Total amount repaid	•¹² €136,234.16	
	(e)		•¹³ State one advantage	•¹³ Lower initial monthly repayments	**2**
			•¹⁴ State one disadvantage	•¹⁴ Longer repayment period, Banco d'Oro mortgage costs €12,044.29 more	

[END OF SPECIMEN MARKING INSTRUCTIONS]

Change since last published:

Marking instructions for question 3 (a) (ii) changed to 2 marks instead of 3 to match the question paper.

Dates in the marking instructions for question 4 (b) have been amended.