H

National Qualifications
ADDITIONAL SPECIMEN

Mark

S844/76/01

Applications of Mathematics

Date — Not applicable

Duration — 2 hours 30 minutes

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day   Month   Year   Scottish candidate number

Total marks — 80

Attempt ALL questions.

You may use a calculator.

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

You should refer to the pre-release material for Higher Applications of Mathematics which you can access electronically.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting.

Questions 3 (a) (i), (b) (i) and (c) and 10 (a), (c) and (d) must be completed on software and then be printed.

Use **blue** or **black** ink.

Before leaving the examination room you must place this booklet and your printouts inside the clear envelope provided. You must give this envelope to the Invigilator; if you do not, you may lose all the marks for this paper.

Information and instructions for candidates

The electronic files listed below are provided for you to use during this examination:

- **Q3 Pizza delivery** — a spreadsheet file containing 1 worksheet (Pizza Delivery)

- **Q3 Pizza delivery answers** — a word processing file

- **Q10 House purchase** — a spreadsheet file containing 3 worksheets ('Historic Exchange Rates', 'Banco de Plata Savings', 'Banco de Plata Mortgage')

Your output from the statistical software in questions 3 (a) (i), (b) (i) and (c) must be copied and pasted into the file 'Q3 Pizza delivery answers' for printing.

You must display your name, SCN and the question number on all electronic files for printing.

Use this table to make sure you have all the printouts required.

| Question	Printout	Completed (✓)
3 (a) (i)	Graph	
3 (b) (i)	Calculation	
3 (c)	Hypothesis test	
10 (a)	'Banco de Plata Savings' worksheet • value view • formula view	
10 (c)	'Banco de Plata Mortgage' worksheet • value view • formula view	
10 (d)	'Banco d'Oro Mortgage' worksheet • value view • formula view	

Attempt ALL questions.

Total marks — 80

1. The following activity network diagram is used to plan a construction project:
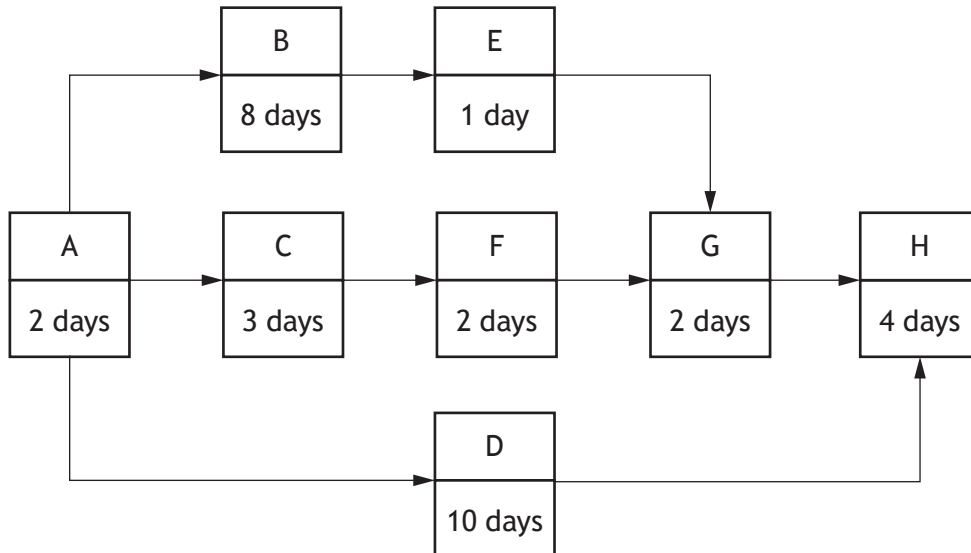
(a) (i) State the definition of the 'critical path' of a project. **1**

(ii) Determine the critical path for the project above. **1**

(b) The project is due to start on Monday 3 February, with work only carried out on weekdays.

Assuming no delays, state the earliest possible completion date. **2**

[Turn over

1. (continued)

(c) Calculate the maximum number of days that Activity C could be delayed without causing a change to the completion date.

1

(d) Activity D initially involves the hiring of specialist equipment to be used on Activity H.

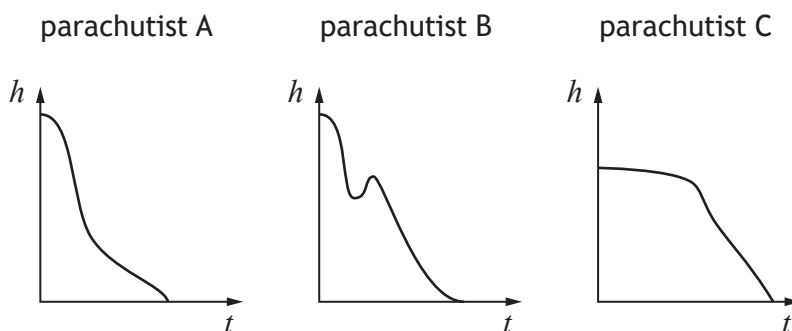State the date you would advise that this activity is started.

Give a reason for your answer.

2

2. The three diagrams, below, show how parachutists' heights vary above the ground over a period of time.

| parachutist A | parachutist B | parachutist C |

State which graph could not model their jump.

Explain your answer clearly.   **2**

[Turn over

3. You must refer to the spreadsheet file 'Q3 Pizza delivery' when answering this question. You must complete parts (a)(i), (b)(i) and (c) using statistical software. You must copy and paste your answers to parts (a)(i), (b)(i) and (c) into the word processing file 'Q3 Pizza delivery answers'. Parts (a)(ii), (b)(ii) and (d) must be completed in the answer spaces provided.

The data in the spreadsheet file shows the times (in minutes) for pizzas to be delivered by Pizza Palace and Pentominos.

(a) (i) Illustrate the data on a suitable graph. **1**

   (ii) Make two valid comments comparing the delivery times between the two companies. **2**

(b) (i) Calculate appropriate descriptive statistics to summarise the delivery times for each company. **2**

   (ii) Give a reason for your choice. **1**

(c) Use a hypothesis test to determine if there is a significant difference in average delivery times. **3**

(d) Comment on which company you would choose if you want a pizza in a hurry. **1**

Print your answers to 3 (a)(i), (b)(i) and (c).

4. James started University on 1 September 2014 and finished on 30 June 2018.

He received a student loan of £5000 on the 1 September each year while he studied.

Student loan interest rates (per annum)

Dates	Interest rate
1 September 2014 to 31 August 2015	1.5%
1 September 2015 to 31 August 2016	0.9%
1 September 2016 to 30 November 2017	1.25%
1 December 2017 to 31 August 2018	1.5%
1 September 2018 to 31 August 2019	1.75%

(a) Calculate how much James owed for his student loan when he finished University.

4

Student loan repayments are only paid when somebody earns over a certain amount. This amount is called the threshold.

Loan repayments are calculated at 9% of the amount earned over the threshold.

The threshold on 6 April 2018 was £1577 per month (before deductions).

After finishing University James started a job.

He started his job on the 1 September 2018 and was paid monthly at the end of each month.

He was paid £32,000 per annum.

James makes a single loan repayment to cover the period from September to March on 31 March 2019.

(b) Calculate the amount James owes on his student loan on 1 April 2019.

3

[Turn over

5. A group of students were asked which types of TV programmes they watch regularly from a choice of comedy, reality and drama.

The results were as follows:

- 60 watch comedy
- 55 watch reality
- 21 watch drama
- 45 watch both comedy and reality
- 12 watch both reality and drama
- 14 watch both drama and comedy
- 8 watch **all three** of these programmes regularly
- 2 watched **none** of these programmes regularly

(a) Complete the Venn diagram to show this information: **3**

comedy   reality
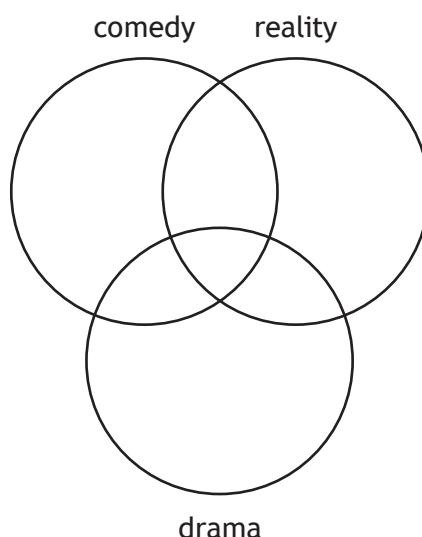
drama

(b) If a student is selected randomly, find the probability that they watch reality and drama TV programmes but not comedy TV programmes. **2**
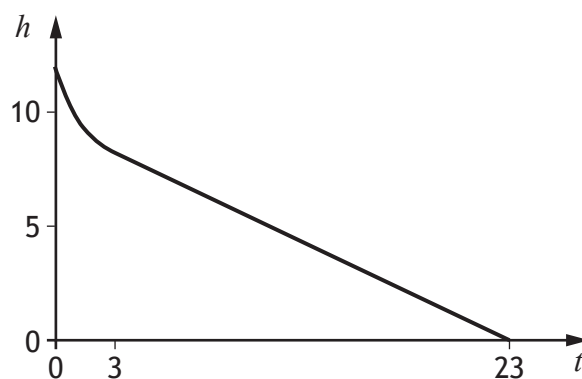
6. A candle company produces a candle. The top part of the candle is in the shape of a cone with a cylinder at the bottom.

The cylinder has a diameter of 6 cm and a height of 7 cm. The total height of the candle is 12 cm, as shown in the diagram.

12 cm

7 cm

6 cm
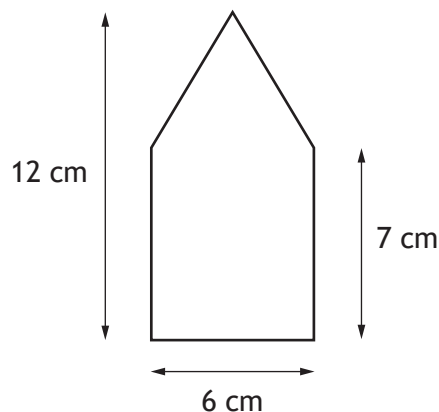
As the candle burns, the height of the candle is recorded.

The graph shows how the candle's height, h cm, varies with time, t hours.

(a) Explain why the initial part of the graph is not a straight line. **1**

[Turn over

6. (continued)

After the upper part of the candle has burned the height, h cm, follows the model, $h = mt + c$.

(b) Calculate the rate of change in the graph, which is represented by m in the model.

3

The company wants to change the length of the candle burn, they also want the diameter of both parts to stay the same and also the length of the initial burn to remain the same.

(c) Calculate the total height of the new candle if they wish it to burn for 40 hours.

3

7. Zainab currently works 3 days per week part-time and earns a gross salary of £12,500 per year.

(For all calculations assume there are 52 weeks in a year.)

The Scottish tax bands and National Insurance contributions given in the Pre-release material apply throughout this question.

(a) Calculate how much Zainab earns in a year in her current job after any tax and National Insurance contributions.

3

- Zainab pays £45 per day for childcare and £10 per day for travel.
- Zainab is entitled to 25 days annual leave working full-time or $\frac{3}{5}$ of these working part-time.
- Childcare and travel are not required during annual leave.
- Zainab is paid in 12 equal monthly payments per year.

(b) Calculate how much Zainab will earn per month, on average, after all her costs are deducted.

3

[Turn over

7. (continued)

Zainab has been offered a full-time promotion.

- The promoted position has a gross salary of £24,450.
- Full-time positions are 5 days per week.

(c) Zainab states she will be more than £248 better off per month working full-time.

Determine if she is correct.

Justify your answer by calculations. 4

(d) Zainab decides to accept the full-time promotion.

State two reasons for this decision. 2

8. A storage company charges £30 per week for a storage room when booked in advance.

If the room is needed for longer than booked, the hire charge for each extra week is £40.

Greg is moving house and needs to put his belongings into storage.

It is expected that he will move into his new home in 4 weeks.

It is estimated that there is a 40% chance that the move will be delayed, and the storage room will be needed for longer than 4 weeks.

It is estimated that, if the move is delayed, there is a 90% chance that the room will be needed for 1 extra week and a 10% chance that it will be needed for 2 extra weeks.

Greg has three options:

Option A

Hire the room for 4 weeks.

If the move is delayed, pay the increased hire charge.

Option B

Hire the room for 5 weeks.

If the move is further delayed, pay the increased hire charge.

Option C

Hire the room for 6 weeks.

(a) Calculate the expected cost of Option C. **1**

[Turn over

8. (continued)

(b) Calculate the probability of the following events occurring:

(i) the room will be needed for 1 extra week   **1**

(ii) the room will be needed for 2 extra weeks.   **1**

(c) Calculate the expected cost of **Option A**.   **3**

(d) Calculate the expected cost of **Option B**.   **2**

(e) Based on the cost analysis, make a recommendation of which option Greg should choose.

Justify your answer.   **1**

9. A food company produces evaporated milk.

The average amount of evaporated milk produced is 1600 litres per hour.

The evaporated milk is sold in cans.

The cans are cylindrical in shape with a diameter of 6 cm and a height of 11.7 cm.

The food company must buy 1 m by 1 m sheets of steel to make the cans.

(a)   (i)   State the relationship between the evaporated milk production rate, R (expressed in litres per month), the volume of a can, V (expressed in litres), and the number of cans required per month, N.   **1**

(ii)   Estimate the number of cans that the food company must produce per month, stating any assumptions that you make.   **2**

(iii)   Estimate the number of sheets, to the nearest 1000, that the food company must buy per month, stating any assumptions that you make.   **2**

[Turn over

9. (continued)

(b) If production is more than expected, the food company can buy up to 3000 extra sheets of steel per month.

Calculate the percentage evaporated milk production can vary without running out of cans.

2

10. You must refer to the spreadsheet file Q10 House purchase when answering this question. You must complete parts (a), (c) and (d) using the spreadsheet file. Parts (b) and (e) must be completed in the answer spaces provided.

Sophie intends to buy a house in Spain. She opens a bank account with Banco de Plata to save for the deposit.

On the 1 January 2014 she made an initial deposit of £17,000 followed by a series of annual payments as shown on the 'Banco de Plata Savings' worksheet.

The annual effective rates of interest (AER) for the five-year period are shown in the worksheet.

(a) Using the relevant exchange rates from the 'Historic Exchange Rates' worksheet, complete the 'Banco de Plata Savings' worksheet to show that the balance at 1 January 2019 will be €41,486.05.

Print the 'Banco de Plata Savings' worksheet in:

- value view

- formula view. **3**

Sophie must pay a 30% deposit to get a mortgage with Banco de Plata with a fixed interest rate of 2.5% per annum effective for 20 years.

(b) Calculate the maximum value of property Sophie can afford to buy. **1**

Sophie decides to buy a property with this maximum value. She uses her savings to fund the deposit and takes out a mortgage with Banco de Plata to cover the remaining balance of the property.

The loan will be repaid by making level annual repayments at the end of each year.

(c) Open the 'Banco de Plata Mortgage' worksheet. Complete formulae in the loan schedule and hence calculate the total amount repayable to Banco de Plata over the 20-year term.

Print the 'Banco de Plata Mortgage' worksheet in:

- value view

- formula view. **5**

[Turn over

10. **(continued)**

Another Spanish bank, Banco d'Oro, offers Sophie a mortgage of the same amount. The level annual repayment is calculated assuming the annual effective interest rate is 1.5% fixed for 25 years.

After the repayment made at time 5 years, Banco d'Oro changes the interest rate to 3.5% for the remainder of the term of the loan.

The loan will be repaid by making level annual repayments at the end of each year.

(d) Create a new worksheet by copying over the 'Banco de Plata Mortgage' worksheet and rename it 'Banco d'Oro Mortgage'. By adapting the formulae, calculate the total amount repayable to Banco d'Oro over the full 25-year term.

Print the 'Banco d'Oro Mortgage' worksheet in:

- value view

- formula view. **3**

(e) State one advantage and one disadvantage of Sophie taking out the Banco d'Oro mortgage instead of the Banco de Plata mortgage. **2**

[END OF SPECIMEN QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL SPACE FOR ANSWERS

H

National Qualifications
ADDITIONAL SPECIMEN

S844/76/11

Applications of Mathematics
Data Booklet

Date — Not applicable

Duration — 2 hours 30 minutes

Pre-release material

This booklet will be issued to centres in advance of the date of examination.

Candidates will be issued with a clean copy of this booklet. Copies will be issued at the start of the examination session and collected at the end of the session. Candidates must not take their own copies of this booklet into the examination.

Centres should ensure that candidates are familiarised with the contexts and information contained in this booklet in preparation for the examination.

Some examination questions will be based on this material.

This booklet contains a set of four documents:

1. Scottish tax bands 2019/20
2. National Insurance contributions
3. Historic exchange rates
4. Some helpful R commands

S8447611

1. Scottish tax bands 2019/20

Band	Taxable income	Scottish tax rate
Personal Allowance	Up to £12,500	0%
Starter rate	£12,501 to £14,549	19%
Basic rate	£14,550 to £24,944	20%
Intermediate rate	£24,945 to £43,430	21%
Higher rate	£43,431 to £150,000	41%
Top rate	over £150,000	46%

2. National Insurance contributions

You begin paying **National Insurance** once you earn more than £166 a week (this is the amount for the 2019-20 tax year). The **National Insurance** rate you pay depends on how much you earn: 12% of your weekly earnings between £166 and £962; 2% of your weekly earnings above £962.

3. Historic exchange rates

£	2013 (€)	2014 (€)	2015 (€)	2016 (€)	2017 (€)	2018 (€)	2019 (€)
Jan	1.203	1.208	1.303	1.327	1.162	1.132	1.129
Feb	1.160	1.213	1.350	1.289	1.172	1.132	1.145
March	1.164	1.203	1.383	1.281	1.154	1.132	1.167
Apr	1.176	1.212	1.383	1.261	1.179	1.145	1.159
May	1.179	1.226	1.384	1.284	1.169	1.139	1.150
Jun	1.174	1.243	1.389	1.265	1.140	1.139	1.122
Aug	1.163	1.254	1.414	1.190	1.129	1.127	1.091
Sep	1.187	1.264	1.400	1.174	1.116	1.119	1.121
Oct	1.180	1.269	1.366	1.120	1.123	1.133	1.143
Nov	1.193	1.265	1.415	1.152	1.126	1.135	1.165
Dec	1.195	1.269	1.377	1.185	1.132	1.114	1.180

4. Some helpful R commands

Entering data to R Studio

To read in data from an Excel csv file called *excel_data.csv* to R Studio and name it `mydata`, first use the drop down menus in R Studio **Session > Set Working Directory > Choose Directory** to indicate the location of *excel_data.csv* on your computer. The following code will then read the data into R Studio:

```
mydata<-read.csv("excel_data.csv")
```

`attach(mydata)` — this adds the variable names

At the end of the analysis remember to use `detach(mydata)` to disassociate the variable names.

(a) Graphics

<u>If you have the numeric variables X and Y:</u>

`hist(X, main= "Title",xlab="x-axis label",ylab="Frequency")` — this produces a histogram of the variable named X, it adds a title and axis labels

`boxplot(Y, main="Title", ylab="y-axis label")` — produces a boxplot of the numerical variable Y

`boxplot(X,Y, main="Title", xlab="x-axis label", ylab="y-axis label", names=c("X","Y"))` — produces a comparative boxplot of the numerical variables X and Y

`plot(X,Y, main="Scatterplot of Y on X",xlab="x-axis label",ylab="y-axis label")` — produces a scatterplot of Y on X

<u>If you have the categorical variable X:</u>

`table(X)` — computes the number of observations in each level of the categorical variable X

`pie(table(X), main="Title")` — this gives a simple pie chart of the categories in variable X with the specified title

`barplot(table(X), main="Title", xlab="x-axis label", ylab="Frequency")` — this gives a bar chart of the categorical variable X with the required title and axis labels

[Turn over

(b) Descriptive Statistics

`mean(X)` — computes the mean of the numerical variable X

`sd(X)` — computes the standard deviation of the numerical variable X

`summary(X)` — computes the mean, median, minimum, maximum and upper and lower quartiles of the numerical variable X

`IQR(X)` — computes the interquartile range of the numerical variable X

`prop.table(table(X))` — returns the proportion of observations in each level of the categorical variable X

`prop.table(table(X))*100` — returns the percentage of observations in each level of the categorical variable X

`table(X,Y)` — produces a cross-tabulation between the two categorical variables X and Y

(c) Correlation and Regression

`cor.test(X,Y)` — computes the correlation between X and Y and performs a test of the null hypothesis of zero correlation

`lm(Y~X)` — fits a linear regression line to the data (lm command stands for linear model)

`abline(lm(Y~X))` — adds the least squares linear regression line to an existing scatterplot of Y on X

`summary(lm(Y~X))` — displays the coefficient of determination (R-squared)

To predict with your Linear Model:

`predict(lm(Y ~ X), newdata=data.frame(X=C),interval = "pred")` — computes the predicted value of Y when X=C along with a 95% prediction interval

(d) Hypothesis Testing

`t.test(X,Y)` — performs a two-sample t-test between X and Y

`t.test(X,Y,paired=TRUE)` — performs a paired t-test between X and Y

`prop.test(x = c(a, b), n = c(n1, n2))` — performs a two-sample test for equality of proportions

[END OF DATA BOOKLET]

H

National Qualifications
ADDITIONAL SPECIMEN

S844/76/01

Applications of Mathematics

Marking Instructions

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:

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

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

$\dfrac{15}{12}$ 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)	•^{1} State definition of critical path	•^{1} eg The sequence of activities that allows the project to be completed in the shortest timescale	1
		(ii)	•^{2} List activities in order	•^{2} ABEGH	1
	(b)		•^{3} Calculate number of days to complete •^{4} State completion date	•^{3} 17 days •^{4} 25 February	2
	(c)		•^{5} State maximum number of days	•^{5} 4 days	1
	(d)		**Option 1** •^{6} State start date •^{7} State valid reason for selected date **Option 2** •^{6} State start date •^{7} State valid reason for selected date	**Option 1** •^{6} 5 February •^{7} Hired in time to avoid any potential delays or issues **Option 2** •^{6} 6 February •^{7} eg Minimise hire costs	2
Notes: 1. Accept any other valid reason for •^{7}					
2.			•^{1} State graph •^{2} Give appropriate explanation	•^{1} Graph B •^{2} Explain that the parachutist cannot go upwards at any point during the jump	2

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

		(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

| | | (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)		$\bullet^7$ Perform appropriate test	$\bullet^7$ Two sample t-test	3
			$\bullet^8$ Interpret result of test	$\bullet^8$ $p = 0.532$, do not reject the null hypothesis	
			$\bullet^9$ Relate result to context of question	$\bullet^9$ 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)		$\bullet^{10}$ Make appropriate comment	$\bullet^{10}$ 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)		$\bullet^1$ Calculate the amount owed on 31 August 2015	$\bullet^1$ £5075	4
			$\bullet^2$ Calculate the amount owed on 31 August 2017	$\bullet^2$ £15,355.25	
			$\bullet^3$ Calculate the amount owed on 30 November 2017	$\bullet^3$ £20,418.56	
			$\bullet^4$ Calculate the amount owed 30 June 2018	$\bullet^4$ £20,596.67	
	(b)		$\bullet^5$ Calculate total monthly payments	$\bullet^5$ £686.49	3
			$\bullet^6$ Calculate the amount owed on 31 March 2019	$\bullet^6$ £20,857.86	
			$\bullet^7$ Calculate the amount owed on 1 April 2019	$\bullet^7$ £20,171.37	
5.	(a)		$\bullet^1$ Interpret 'watch **all three**'	$\bullet^1$ 8 placed where three circles overlap	3
			$\bullet^2$ Interpret 'watch **none**'	$\bullet^2$ 2 placed 'outside' circles	
			$\bullet^3$ Complete Venn diagram	$\bullet^3$ Remaining values completed correctly	
	(b)		$\bullet^4$ Find total number of students	$\bullet^4$ 75	2
			$\bullet^5$ Determine probability	$\bullet^5$ $\dfrac{4}{75}$	
6.	(a)		$\bullet^1$ State appropriate explanation	$\bullet^1$ As candle is not a constant width, the wider the candle the longer it takes for height to reduce	1
	(b)		$\bullet^2$ Identify height of graph after 3 hours	$\bullet^2$ 7 cm	3
			$\bullet^3$ Calculate rate of change	$\bullet^3$ $\dfrac{7}{20}$ or 0.35	
			$\bullet^4$ State rate of change with correct units	$\bullet^4$ ... cm per hour	
	(c)		$\bullet^5$ Identify additional hours	$\bullet^5$ 17	3
			$\bullet^6$ Calculate extra height	$\bullet^6$ 5.95	
			$\bullet^7$ Determine height of candle	$\bullet^7$ 17.95 (cm)	

Notes:
1. For marks $\bullet^6$ and $\bullet^7$ 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)	$\bullet^1$ State relationship between variables	$\bullet^1$ $N = \dfrac{R}{V}$	1
		(ii)	$\bullet^2$ State number of hours of production per month and calculate the number of litres produced per month.	$\bullet^2$ eg 20 days production per month at 8 hours per day, leading to 256 000 litres per month	2
			$\bullet^3$ Calculate the volume of one can and hence calculate the total number of cans per month	$\bullet^3$ $V = \pi \times 3^2 \times 11.7 \approx 331\,\text{cm}^3$, approximately 774 000 cans required per month	

Notes:
1. At $\bullet^2$, 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 $\bullet^3$ for the omission of units. Do not withhold similar marks in subsequent questions
3. Acceptable ranges for hours per month 28 to 744

		(iii)	$\bullet^4$ Calculate the amount of steel required per can	$\bullet^4$ $\approx 277\ \text{cm}^2$	2
			$\bullet^5$ State assumptions and estimate number of sheets required	$\bullet^5$ 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	

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

	(b)		$\bullet^6$ Identify that number of sheets required is proportional to evaporated milk production	$\bullet^6$ $N = \dfrac{R}{V}$, the number of sheets required is proportional to production rate	2
			$\bullet^7$ Estimate the relative tolerance	$\bullet^7$ 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	

Notes:
1. At $\bullet^6$, 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]