FOR OFFICIAL USE

National Qualifications 2024

Mark

X844/76/01 Applications of Mathematics

FRIDAY, 3 MAY

9:00 AM – 11:05 AM

X8447601

Fill in these boxes and read what is printed below.

Full name of centre: WORKED SOLUTIONS

Town

Forename(s)

Surname: HK.

Number of seat

Date of birth

Day Month Year

Scottish candidate number

Total marks — 65

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 4, 6 and 9 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.

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Information and instructions for candidates

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

- **'Q4 Dracaena Plant.xlsx'** — a spreadsheet file containing 1 worksheet
- **'Q6 golf.csv'** — a spreadsheet file containing a data set
- **'Q6 Golf Answers.docx'** — a word processing file. Your output from the statistical software in questions 6 (a) (i) and (c) (ii) must be copied and pasted into this file for printing.
- **'Q9 Esme's Mortgage.xlsx'** — a spreadsheet containing 2 worksheets

You must display your name, SCN and centre name on all pages on each printout. Spaces have been provided in each electronic file for you to complete this information.

When printing spreadsheet files, ensure that:

- landscape orientation is used
- grid lines are shown
- row and column headings are shown
- the option 'Fit All Columns on One Page' is selected.

When printing word processing files ensure that portrait orientation is used.

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

Question	Printout	Completed (✓)
4 (a) and (b)	'Dracaena plant study' worksheet • value view • formula view This should include the graph.	✓ ✓
6 (all parts)	'Q6 Golf Answers.docx' This should include your statistical software output, and answers.	✓
9 (a)	'Mortgage' worksheet • value view • formula view	✓ ✓
9 (c)	'Increased payments' worksheet • value view • formula view	✓ ✓

MARKS | DO NOT WRITE IN THIS MARGIN

Total marks — 65

Attempt ALL questions

1. Bailey takes out a loan for £4000 with an annual effective rate of interest of 29.9%.

(a) Calculate the monthly effective rate of interest. 1

Annual : $100\% + 29.9\% = 129.9\% = 1.299$

Monthly : $(1.299^{\frac{1}{12}} - 1) \times 100 = 2.20389...$

Monthly effective rate = 2.20%

Bailey makes level monthly repayments of £250 at the end of each month.

(b) Complete the following loan schedule for Bailey's loan to show the loan outstanding at the end of month 2. 2

Time (months)	Repayment (£)	Interest content of repayment (£)	Capital content of repayment (£)	Loan outstanding (£)
0				4000.00
1	250.00	88.00	162.00	3838.00
2	250.00	84.44	165.56	3672.44

Space for working if required

Month ① : Interest = 2.20% of £4000 = £88

Capital = 250 − 88 = £162

Loan = 4000 − 162 = £3838

Month ② Interest = 2.20% of £3838 = £84.44

Capital = 250 − 84.44 = £165.56

Loan = 3838 − 165.56 = £3672.44

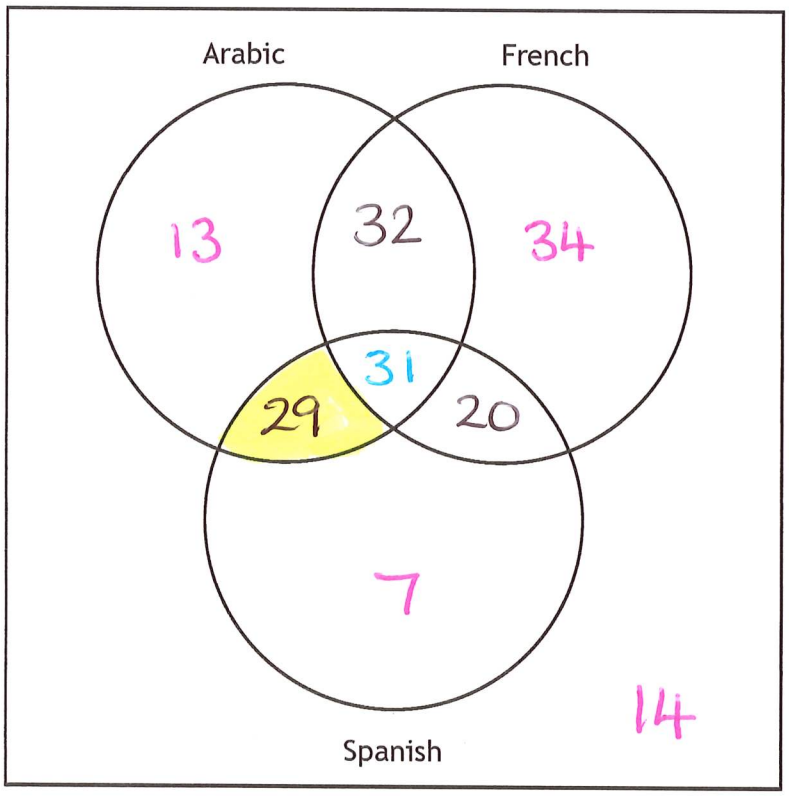
MARKS | DO NOT WRITE IN THIS MARGIN

2. A college offers language courses in French, Spanish and Arabic.

A group of students are asked which, if any, of these language courses they study at this college:

- 31 students study French, Spanish and Arabic
- 34 students study French only
- 7 students study Spanish only
- 13 students study Arabic only
- 51 students study French and Spanish $51 - 31 = 20$
- 60 students study Spanish and Arabic $60 - 31 = 29$
- 63 students study French and Arabic $63 - 31 = 32$
- 14 students study no languages.

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



(An additional diagram, if required, can be found on *page 20*.)

2. (continued)

(b) A student is selected at random.

Determine the probability that the student studies Spanish and Arabic, but not French. 2

Total number of students

$13 + 32 + 34 + 29 + 31 + 20 + 7 + 14 = 180$

$P(\text{Spanish and Arabic but not French}) = \frac{29}{180}$

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

3. A ship is being repaired.

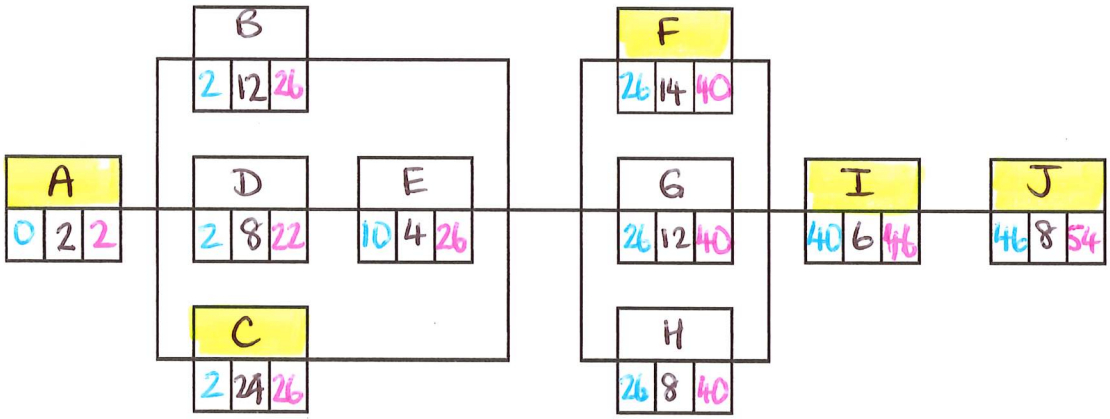
The propeller must be removed for the repair to be carried out.

The table shows the list of tasks required to complete this job, the time required for each task, and the order in which the tasks must be completed.

Task	Description	Preceding task	Duration (hours)
A	Disconnect electrics	none	2
B	Remove oils from system	A	12
C	Remove rudder	A	24
D	Disconnect oil pipes and hoses	A	8
E	Prepare oil pipes and hoses to be reconnected	D	4
F	Remove propeller blades	B, C, E	14
G	Disconnect propeller stern seals	B, C, E	12
H	Disconnect propeller shaft coupling	B, C, E	8
I	Remove propeller shaft coupling and internal pipes	F, G, H	6
J	Take out propeller shaft	I	8

(a) Complete the PERT chart showing the earliest start time and the latest completion time for each task. 5

(An additional diagram, if required, can be found on *page 21*.)

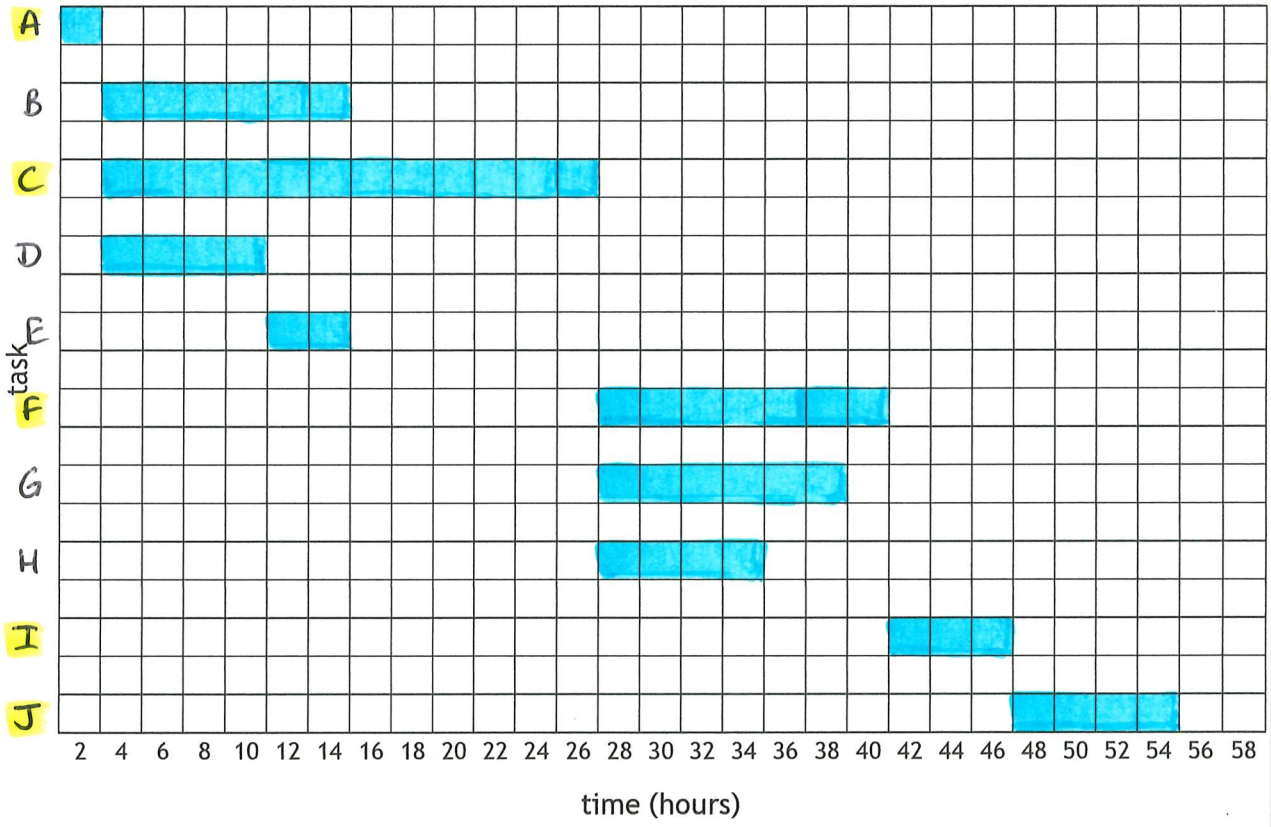


MARKS | DO NOT WRITE IN THIS MARGIN

3. (continued)

(b) Construct a Gantt chart without float times for this job. 3

(An additional diagram, if required, can be found on *page 21*.)



(c) Determine the critical path and the minimum time required to complete the job. 2

Critical Path = A – C – F – I – J.

Minimum time required is 54 hours.

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MARKS | DO NOT WRITE IN THIS MARGIN

3. **(continued)**

During the job there are difficulties disconnecting the propeller shaft coupling (task H).

(d) Determine the maximum time that can be taken to disconnect the propeller shaft coupling without delaying the total completion time of the job. 1

Task H = 40 − 26 = 14 hours.

The maximum time to complete the task without delaying the job is 14 hours.

(The task can be delayed by up to 6 hours)

4. You must refer to the information on 'Dracaena plants and atmospheric carbon dioxide levels' given in the pre-release material when answering this question.

You must also refer to the spreadsheet file 'Q4 Dracaena Plant.xlsx' when answering this question.

You must complete parts (a) and (b) using the spreadsheet file.

Part (c) must be completed in the answer space provided.

A research scientist is studying the effect of Dracaena plants to improve indoor air quality in a kitchen showroom. They estimate that:

- large Dracaena plants reduce the concentration of carbon dioxide (CO_2) in the showroom by 13% each day
- each evening a heating system is left running. This adds enough CO_2 to increase the concentration in the showroom by 180 ppm.

At the start of the study the concentration of CO_2 in the showroom was 2000 ppm.

(a) Complete the 'Dracaena plant study' worksheet to estimate the concentration of CO_2 at the end of 30 days. **3**

The research scientist investigates the long-term concentration of CO_2 in the showroom.

(b) Extend the table in your worksheet to the end of 60 days.

Construct a graph to show what will happen to the concentration of CO_2 in the showroom.

Your graph must include an appropriate title and axes labels. **3**

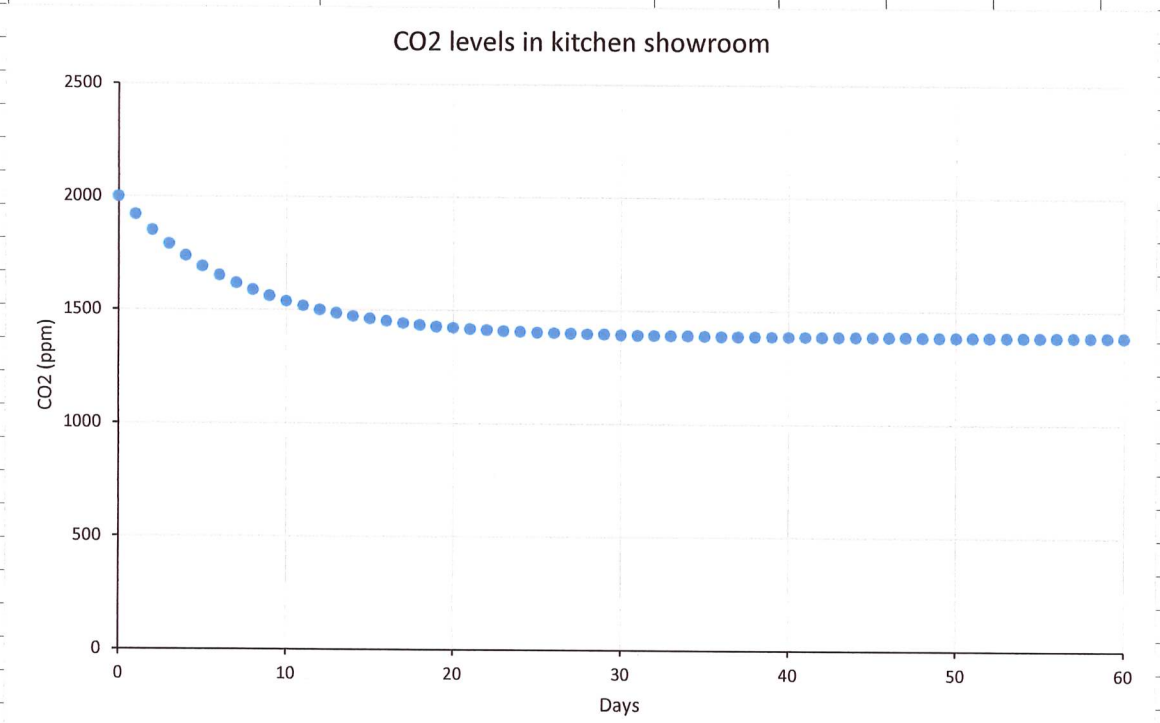
(c) Explain whether the large Dracaena plants are effective at obtaining very good indoor air quality in the showroom. **1**

Whilst the Dracaena plants have reduced CO_2 levels, they are not effective at obtaining very good air quality in the showroom because the concentration of CO_2 remains above 800 ppm.

Print the 'Dracaena plant study' worksheet in value view and in formula view. Ensure the graph is positioned beside the table and is contained on one page in the printout.

	A	B	C	D	E	F	G	H
1		**Name:**	H WALLACE					
2		**SCN:**						
3		**Centre name:**	WORKED SOLUTIONS					
4								
5		**Draecaena Plant Study**						
6						VALUE VIEW.		
7		Initial measurement of CO2 concentration in showroom		2000				
8		Reduction (%)		13%				
9		Level of CO_2 at end of day (%)		87%				
10		Additional CO_2 emitted by heating system		180				
11		CO_2 level at the end of 30 days		1394.05				
12								
13		**Day**	**CO_2(ppm)**					
14		0	2000					
15		1	1920					
16		2	1850.4					
17		3	1789.848					
18		4	1737.16776					
19		5	1691.335951					
20		6	1651.462278					
21		7	1616.772181					
22		8	1586.591798					
23		9	1560.334864					
24		10	1537.491332					
25		11	1517.617459					
26		12	1500.327189					
27		13	1485.284654					
28		14	1472.197649					
29		15	1460.811955					
30		16	1450.906401					
31		17	1442.288569					
32		18	1434.791055					
33		19	1428.268218					
34		20	1422.593349					
35		21	1417.656214					
36		22	1413.360906					
37		23	1409.623988					
38		24	1406.37287					
39		25	1403.544397					
40		26	1401.083625					
41		27	1398.942754					
42		28	1397.080196					
43		29	1395.45977					
44		30	1394.05					
45		31	1392.8235					
46		32	1391.756445					
47		33	1390.828107					
48		34	1390.020453					
49		35	1389.317794					
50		36	1388.706481					
51		37	1388.174639					
52		38	1387.711936					
53		39	1387.309384					
54		40	1386.959164					
55		41	1386.654473					
56		42	1386.389391					
57		43	1386.15877					

	A	B	C	D	E	F	G	H
1		Name:	H WALLACE					
2		SCN:						
3		Centre name:	WORKED SOLUTIONS					
4								
5		Draecaena Plant Study						
58		44	1385.95813					
59		45	1385.783573					
60		46	1385.631709					
61		47	1385.499587					
62		48	1385.38464					
63		49	1385.284637					
64		50	1385.197634					
65		51	1385.121942					
66		52	1385.056089					
67		53	1384.998798					
68		54	1384.948954					
69		55	1384.90559					
70		56	1384.867863					
71		57	1384.835041					
72		58	1384.806486					
73		59	1384.781643					
74		60	1384.760029					
75								
76								



	A	B	C	D	E	F	G	H
1		**Name:**	H WALLACE					
2		**SCN:**						
3		**Centre name:**	WORKED SOLUTIONS					
4								
5		**Draecaena Plant Study**						
6								
7		Initial measurement of CO2 concentration in showroom		2000		FORMULAE VIEW.		
8		Reduction (%)		0.13				
9		Level of CO_2 at end of day (%)		=1-D8				
10		Additional CO_2 emitted by heating system		180				
11		CO_2 level at the end of 30 days		=C44				
12								
13		**Day**	**CO_2(ppm)**					
14		0	=D7					
15		1	=C14*$D$9+$D$10					
16		2	=C15*$D$9+$D$10					
17		3	=C16*$D$9+$D$10					
18		4	=C17*$D$9+$D$10					
19		5	=C18*$D$9+$D$10					
20		6	=C19*$D$9+$D$10					
21		7	=C20*$D$9+$D$10					
22		8	=C21*$D$9+$D$10					
23		9	=C22*$D$9+$D$10					
24		10	=C23*$D$9+$D$10					
25		11	=C24*$D$9+$D$10					
26		12	=C25*$D$9+$D$10					
27		13	=C26*$D$9+$D$10					
28		14	=C27*$D$9+$D$10					
29		15	=C28*$D$9+$D$10					
30		16	=C29*$D$9+$D$10					
31		17	=C30*$D$9+$D$10					
32		18	=C31*$D$9+$D$10					
33		19	=C32*$D$9+$D$10					
34		20	=C33*$D$9+$D$10					
35		21	=C34*$D$9+$D$10					
36		22	=C35*$D$9+$D$10					
37		23	=C36*$D$9+$D$10					
38		24	=C37*$D$9+$D$10					
39		25	=C38*$D$9+$D$10					
40		26	=C39*$D$9+$D$10					
41		27	=C40*$D$9+$D$10					
42		28	=C41*$D$9+$D$10					
43		29	=C42*$D$9+$D$10					
44		30	=C43*$D$9+$D$10					
45		31	=C44*$D$9+$D$10					
46		32	=C45*$D$9+$D$10					
47		33	=C46*$D$9+$D$10					
48		34	=C47*$D$9+$D$10					
49		35	=C48*$D$9+$D$10					
50		36	=C49*$D$9+$D$10					

	A	B	C	D	E	F	G	H
1		Name:	H WALLACE					
2		SCN:						
3		Centre name:	WORKED SOLUTIONS					
4								
5		Draecaena Plant Study						
51		37	=C50*$D$9+$D$10					
52		38	=C51*$D$9+$D$10					
53		39	=C52*$D$9+$D$10					
54		40	=C53*$D$9+$D$10					
55		41	=C54*$D$9+$D$10					
56		42	=C55*$D$9+$D$10					
57		43	=C56*$D$9+$D$10					
58		44	=C57*$D$9+$D$10					
59		45	=C58*$D$9+$D$10					
60		46	=C59*$D$9+$D$10					
61		47	=C60*$D$9+$D$10					
62		48	=C61*$D$9+$D$10					
63		49	=C62*$D$9+$D$10					
64		50	=C63*$D$9+$D$10					
65		51	=C64*$D$9+$D$10					
66		52	=C65*$D$9+$D$10					
67		53	=C66*$D$9+$D$10					
68		54	=C67*$D$9+$D$10					
69		55	=C68*$D$9+$D$10					
70		56	=C69*$D$9+$D$10					
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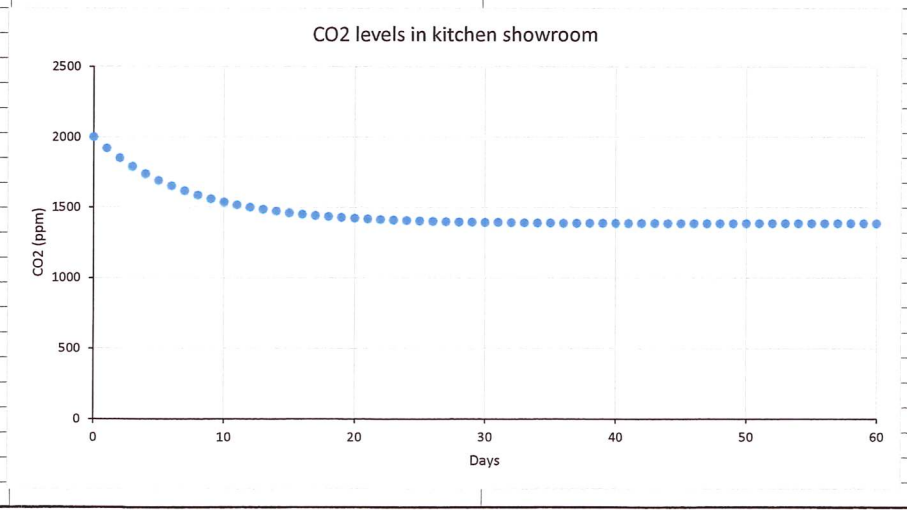
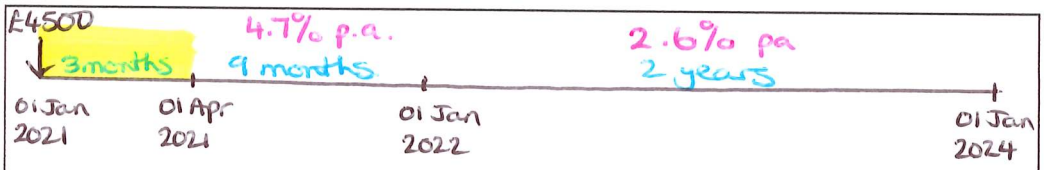


MARKS | DO NOT WRITE IN THIS MARGIN

5. Ewa deposited £4500 in a variable rate savings account on 1 January 2021.
The effective rates of interest for the savings account are as follows:

Dates	Interest rate
1 January 2021 to 31 March 2021	0.415% per month
1 April 2021 to 31 December 2021	4.7% per year
From 1 January 2022	2.6% per year

(a) Calculate Ewa's balance on 1 January 2024. 3



01 Apr 2021 = $4500 \times 1.00415^{3} \approx £4556.26$

01 Jan 2022 = $4556.26 \times 1.047^{9/12} \approx £4715.94$

01 Jan 2024 = $4715.94 \times 1.026^{2} \approx £4964.36$

Ewa's balance on 01 Jan 2024 is £4964.36

On 1 January 2022 Blair opened an account with the same effective rates of interest. Blair has a savings goal of £6000 by 1 January 2024.

(b) Calculate the minimum deposit Blair should have made on 1 January 2022 to achieve this savings goal. 1

2.6% per year

Present Value = $6000 \div 1.026^{2} = 5699.75947\ldots$

Blair would need to invest £5699.76 on 1st Jan 2022 to reach his goal in 2024.

MARKS | DO NOT WRITE IN THIS MARGIN

6. You must refer to the spreadsheet file 'Q6 golf.csv' for the data, and the word processing file 'Q6 Golf Answers.docx' when answering this question.

You must complete parts (a) (i) and (c) (ii) using appropriate statistical software.

You must include all output from statistical software, and your answers in the word processing file 'Q6 Golf Answers.docx'.

A golf ball manufacturing company has designed a new golf ball which is more hard-wearing.

The company wants to determine whether there is a difference in the distances travelled by the current and new golf balls.

To measure the distances travelled by the current and new golf balls, a random sample of 40 of the current golf balls and a random sample of 40 of the new golf balls were subjected to distance tests using a mechanical hitting machine.

Data was collected for the distances travelled (in metres) of both the current and new golf balls.

The data was found to be approximately normally distributed. mean + sd.

(a) (i) Generate and state appropriate measures of location and spread for the current and new golf balls. 2

(ii) Make two valid comparisons about the driving distances of both the current and new golf balls. 2

(b) State appropriate null and alternative hypotheses to determine if there is a statistically significant difference between the distances travelled by the current and new golf balls. 1

(c) (i) State which type of hypothesis test is appropriate to determine if there is a statistically significant difference between the distances travelled by the current and new golf balls. 1

(ii) Perform the hypothesis test and state the p-value. 2

(iii) Hence interpret the p-value, and the result of the hypothesis test, in context. 2

Print the word processing file 'Q6 Golf Answers.docx'.

[Turn over

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(a) (i)

Statistical software output:

	Mean	SD
current	=AVERAGE(A2:A41)	=STDEV.S(A2:A41)
new	=AVERAGE(B2:B41)	=STDEV.S(B2:B41)

Answer:

	Measure of location (metres)	Measure of spread (metres)
Current golf ball	**270.275**	**8.752985**
New golf ball	**267.5**	**9.896904**

(ii)

Answer:

On average, the current golf balls travelled further distance than the new golf balls (270.275m > 267.5m).

The distance travelled by the new golf ball are more varied than those travelled by the current golf ball (9.896904m > 8.752985m).

(b)

Answer:

Null hypothesis:

There is no difference in the mean distances travelled by the current and the new golf balls.

Alternative hypothesis:

There is a difference in the mean distances travelled by the current and the new golf balls.

Name: H WALLACE SCN:

Centre name: WORKED SOLUTIONS (USING EXCEL)

(c) (i)

Answer:

Two-sample t-test.

(ii)

Statistical software output:

t-Test: Two-Sample Assuming Equal Variances

	Variable 1	*Variable 2*
Mean	270.275	267.5
Variance	76.61474359	97.94871795
Observations	40	40
Pooled Variance	87.28173077	
Hypothesized Mean Difference	0	
df	78	
t Stat	1.328361594	
P(T<=t) one-tail	0.093966142	
t Critical one-tail	1.664624645	
P(T<=t) two-tail	0.187932285	
t Critical two-tail	1.990847069	

Answer:

p-value = 0.1879

(iii)

Answer:

Since the p-value is greater than 0.05, we fail to reject the null hypothesis, and there is insufficient evidence to suggest there is not a significant difference in the mean distances travelled by the current golf ball and the new golf ball.

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(a) (i)

Statistical software output:

```
> mean(current)
[1] 270.275
> mean(new)
[1] 267.5
> sd(current)
[1] 8.752985
> sd(new)
[1] 9.896904
```

Answer:

	Measure of location (metres)	Measure of spread (metres)
Current golf ball	**270.275**	**8.752985**
New golf ball	**267.5**	**9.896904**

.

(ii)

Answer:

On average, the current golf balls travelled further distance than the new golf balls (270.275m > 267.5m).

The distance travelled by the new golf ball are more varied than those travelled by the current golf ball (9.896904m > 8.752985m).

(b)

Answer:

Null hypothesis:

There is no difference in the mean distances travelled by the current and the new golf balls.

Alternative hypothesis:

There is a difference in the mean distances travelled by the current and the new golf balls.

Name:	H WALLACE	SCN:									
Centre name:	WORKED SOLUTIONS (USING RSTUDIO)										

(c) (i)

Answer:

Two-sample t-test.

(ii)

Statistical software output:

```
> t.test(current,new)

        Welch Two Sample t-test

data:  current and new
t = 1.3284, df = 76.852, p-value = 0.188
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.384937  6.934937
sample estimates:
mean of x mean of y
  270.275   267.500
```

Answer:

p-value = 0.188

(iii)

Answer:

Since the p-value is greater than 0.05, we fail to reject the null hypothesis, and there is insufficient evidence to suggest there is not a significant difference in the mean distances travelled by the current golf ball and the new golf ball.

MARKS | DO NOT WRITE IN THIS MARGIN

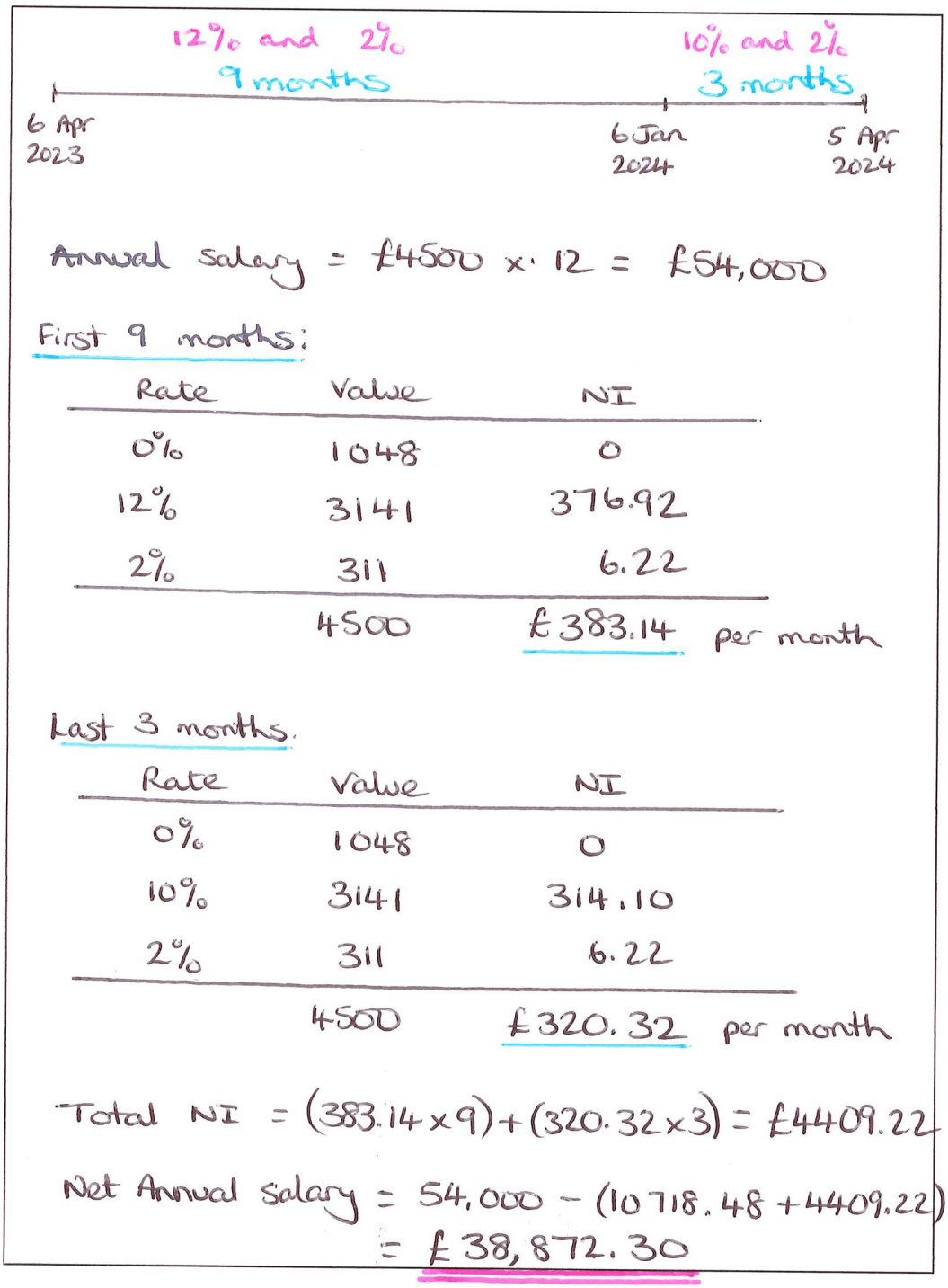
7. You must refer to the information on 'Deductions from salaries' given in the pre-release material when answering this question.

In the 2023/24 tax year, Tom was paid a gross salary of £4500 per month for 12 months, from the 6 April 2023.

His annual income tax deduction is £10,718.48.

Tom has opted out of paying any pension contributions.

(a) Calculate Tom's **net annual salary** for the 2023/24 tax year, after all deductions including National Insurance. 4



Annual salary = £4500 x 12 = £54,000

First 9 months:

Rate	Value	NI
0%	1048	0
12%	3141	376.92
2%	311	6.22
	4500	£383.14 per month

Last 3 months.

Rate	Value	NI
0%	1048	0
10%	3141	314.10
2%	311	6.22
	4500	£320.32 per month

Total NI = (383.14 x 9) + (320.32 x 3) = £4409.22

Net Annual salary = 54,000 − (10718.48 + 4409.22)
= £38,872.30

7. **(continued)**

The Consumer Price Index (CPI) in April 2022 was 119.0 and in April 2023 was 128.3.

In April 2022, Tom's gross monthly salary was £4200.

In April 2023, his gross monthly salary was increased to £4500.

(b) Determine whether Tom's gross monthly salary increased in line with the CPI. 2

CPI inflation $= \frac{128.3}{119.0} = 1.078151\ldots \therefore 7.82\%$

Wage rise $= \frac{4500}{4200} = 1.071428\ldots \therefore 7.14\%$

Tom's monthly salary was not increased in line with inflation since $7.14\% < 7.82\%$

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

8. An electric vehicle charging company has been awarded a contract to install 500 charging points in a city. As part of the contract a number of tasks must be completed including ordering and receiving charger parts and installing electric cables.

If the installation is delayed the company faces a fixed penalty of £75,000.

The company has identified the following two reasons for a possible delay:

- a shortage in parts for the chargers
- the electric cables will not be in place in time.

There is a 0.325 probability one or both of these delays will happen.

(a) Calculate the expected cost of a delay. 1

Expected cost = 0.325 × £75,000

= £24,375

The company is considering using the following control measures:

- Control Measure 1 — Import extra parts at a cost of £15,000.
- Control Measure 2 — Pay another firm to help lay the cables, at an additional cost of £16,000.

There is a 0.1 probability of a shortage in parts for the chargers.

There is a 0.25 probability that the electric cables will not be in place in time.

(b) Calculate the expected cost of a delay using:

(i) only control measure 1, still at risk of cables 1

0.25 × 75000 + £15,000

= £33,750

(ii) only control measure 2., still at risk of shortage of parts. 1

0.1 × 75,000 + £16,000

= £23,500

8. (continued)

The company will only use one control measure.

(c) Based on your calculations, explain which control measure the company should use in order to minimise expected costs. 1

The company should choose control measure 2 as it is cheaper than taking control measure 1.

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

9. You must refer to the spreadsheet file 'Q9 Esme's Mortgage.xlsx' when answering this question.

You must complete parts (a) and (c) (i) using the spreadsheet file.

Part (b) (i), (b) (ii), and (c) (ii) must be completed in the answer box provided.

Esme is building an extension to her house.

She has been offered a £25,000 mortgage with an effective annual rate of interest of 3.5% over 5 years.

Open the 'Mortgage' worksheet.

(a) Complete the 'Mortgage schedule' to determine the level monthly repayment amount, and the final repayment amount. 4

Esme needs new building insurance once the extension is completed.

She is choosing between the following two options.

Cost per year(£)	Total excess(£)
216.94	350
281.95	100

(b) (i) State one advantage of having a high excess amount on your insurance policy. 1

A high excess amount means that the insurance premium will be lower.

One of the windows in Esme's house is broken and she has to decide whether to make a claim.

(ii) Explain why Esme may choose not to make a claim using her insurance policy. 1

The cost of repair may be less than the excess amount on her insurance policy.

	A	B	C	D	E	F
1		Name:	H WALLACE			
2		SCN:				
3		Centre name:	WORKED SOLUTIONS			
4						
5		Mortgage Schedule				
6						
7		Mortgage amount	£ 25,000.00			
8		Annual effective interest rate	3.50%			
9		Monthly effective interest rate	0.29%		VALUE VIEW	
10		Repayment (months)	60			
11		Level monthly repayment	£454.18			
12		Final repayment	£454.12			
13						
14		Time (months)	Repayment (£)	Interest content of repayment (£)	Capital content of repayment (£)	Mortgage outstanding (£)
15		0				25,000.00
16		1	454.18	71.77	382.41	24,617.59
17		2	454.18	70.67	383.51	24,234.08
18		3	454.18	69.57	384.61	23,849.47
19		4	454.18	68.47	385.71	23,463.76
20		5	454.18	67.36	386.82	23,076.94
21		6	454.18	66.25	387.93	22,689.01
22		7	454.18	65.14	389.04	22,299.97
23		8	454.18	64.02	390.16	21,909.81
24		9	454.18	62.90	391.28	21,518.53
25		10	454.18	61.78	392.40	21,126.13
26		11	454.18	60.65	393.53	20,732.60
27		12	454.18	59.52	394.66	20,337.94
28		13	454.18	58.39	395.79	19,942.15
29		14	454.18	57.25	396.93	19,545.22
30		15	454.18	56.11	398.07	19,147.15
31		16	454.18	54.97	399.21	18,747.94
32		17	454.18	53.82	400.36	18,347.58
33		18	454.18	52.67	401.51	17,946.07
34		19	454.18	51.52	402.66	17,543.41
35		20	454.18	50.37	403.81	17,139.60
36		21	454.18	49.21	404.97	16,734.63
37		22	454.18	48.04	406.14	16,328.49
38		23	454.18	46.88	407.30	15,921.19
39		24	454.18	45.71	408.47	15,512.72
40		25	454.18	44.54	409.64	15,103.08
41		26	454.18	43.36	410.82	14,692.26
42		27	454.18	42.18	412.00	14,280.26
43		28	454.18	41.00	413.18	13,867.08
44		29	454.18	39.81	414.37	13,452.71
45		30	454.18	38.62	415.56	13,037.15

	A	B	C	D	E	F
1		Name:	H WALLACE			
2		SCN:				
3		Centre name:	WORKED SOLUTIONS			
4						
46		31	454.18	37.43	416.75	12,620.40
47		32	454.18	36.23	417.95	12,202.45
48		33	454.18	35.03	419.15	11,783.30
49		34	454.18	33.83	420.35	11,362.95
50		35	454.18	32.62	421.56	10,941.39
51		36	454.18	31.41	422.77	10,518.62
52		37	454.18	30.20	423.98	10,094.64
53		38	454.18	28.98	425.20	9,669.44
54		39	454.18	27.76	426.42	9,243.02
55		40	454.18	26.54	427.64	8,815.38
56		41	454.18	25.31	428.87	8,386.51
57		42	454.18	24.08	430.10	7,956.41
58		43	454.18	22.84	431.34	7,525.07
59		44	454.18	21.60	432.58	7,092.49
60		45	454.18	20.36	433.82	6,658.67
61		46	454.18	19.12	435.06	6,223.61
62		47	454.18	17.87	436.31	5,787.30
63		48	454.18	16.61	437.57	5,349.73
64		49	454.18	15.36	438.82	4,910.91
65		50	454.18	14.10	440.08	4,470.83
66		51	454.18	12.84	441.34	4,029.49
67		52	454.18	11.57	442.61	3,586.88
68		53	454.18	10.30	443.88	3,143.00
69		54	454.18	9.02	445.16	2,697.84
70		55	454.18	7.75	446.43	2,251.41
71		56	454.18	6.46	447.72	1,803.69
72		57	454.18	5.18	449.00	1,354.69
73		58	454.18	3.89	450.29	904.40
74		59	454.18	2.60	451.58	452.82
75		60	£454.12	1.30	452.82	0.00
76						
77		Total Repayment	27250.74			

	A	B	C	D	E	F
1		**Name:**	H WALLACE			
2		**SCN:**				
3		**Centre name:**	WORKED SOLUTIONS			
4						
5		**Mortgage Schedule**				
6						
7		Mortgage amount	25000		FORMULAE VIEW	
8		Annual effective interest rate	0.035			
9		Monthly effective interest rate	=(1+C8)^(1/12)-1			
10		Repayment (months)	60			
11		Level monthly repayment	454.18			
12		Final repayment	=C75			
13						
14		**Time (months)**	**Repayment (£)**	**Interest content of repayment (£)**	**Capital content of repayment (£)**	**Mortgage outstanding (£)**
15		0				25000
16		1	=$C$11	=ROUND($C$9*F15, 2)	=C16-D16	=F15-E16
17		2	=$C$11	=ROUND($C$9*F16, 2)	=C17-D17	=F16-E17
18		3	=$C$11	=ROUND($C$9*F17, 2)	=C18-D18	=F17-E18
19		4	=$C$11	=ROUND($C$9*F18, 2)	=C19-D19	=F18-E19
20		5	=$C$11	=ROUND($C$9*F19, 2)	=C20-D20	=F19-E20
21		6	=$C$11	=ROUND($C$9*F20, 2)	=C21-D21	=F20-E21
22		7	=$C$11	=ROUND($C$9*F21, 2)	=C22-D22	=F21-E22
23		8	=$C$11	=ROUND($C$9*F22, 2)	=C23-D23	=F22-E23
24		9	=$C$11	=ROUND($C$9*F23, 2)	=C24-D24	=F23-E24
25		10	=$C$11	=ROUND($C$9*F24, 2)	=C25-D25	=F24-E25
26		11	=$C$11	=ROUND($C$9*F25, 2)	=C26-D26	=F25-E26
27		12	=$C$11	=ROUND($C$9*F26, 2)	=C27-D27	=F26-E27
28		13	=$C$11	=ROUND($C$9*F27, 2)	=C28-D28	=F27-E28
29		14	=$C$11	=ROUND($C$9*F28, 2)	=C29-D29	=F28-E29
30		15	=$C$11	=ROUND($C$9*F29, 2)	=C30-D30	=F29-E30
31		16	=$C$11	=ROUND($C$9*F30, 2)	=C31-D31	=F30-E31
32		17	=$C$11	=ROUND($C$9*F31, 2)	=C32-D32	=F31-E32
33		18	=$C$11	=ROUND($C$9*F32, 2)	=C33-D33	=F32-E33
34		19	=$C$11	=ROUND($C$9*F33, 2)	=C34-D34	=F33-E34
35		20	=$C$11	=ROUND($C$9*F34, 2)	=C35-D35	=F34-E35
36		21	=$C$11	=ROUND($C$9*F35, 2)	=C36-D36	=F35-E36
37		22	=$C$11	=ROUND($C$9*F36, 2)	=C37-D37	=F36-E37
38		23	=$C$11	=ROUND($C$9*F37, 2)	=C38-D38	=F37-E38
39		24	=$C$11	=ROUND($C$9*F38, 2)	=C39-D39	=F38-E39

Question 9(a)

	A	B	C	D	E	F
1		Name:	H WALLACE			
2		SCN:				
3		Centre name:	WORKED SOLUTIONS			
4						
40		25	=$C$11	=ROUND($C$9*F39, 2)	=C40-D40	=F39-E40
41		26	=$C$11	=ROUND($C$9*F40, 2)	=C41-D41	=F40-E41
42		27	=$C$11	=ROUND($C$9*F41, 2)	=C42-D42	=F41-E42
43		28	=$C$11	=ROUND($C$9*F42, 2)	=C43-D43	=F42-E43
44		29	=$C$11	=ROUND($C$9*F43, 2)	=C44-D44	=F43-E44
45		30	=$C$11	=ROUND($C$9*F44, 2)	=C45-D45	=F44-E45
46		31	=$C$11	=ROUND($C$9*F45, 2)	=C46-D46	=F45-E46
47		32	=$C$11	=ROUND($C$9*F46, 2)	=C47-D47	=F46-E47
48		33	=$C$11	=ROUND($C$9*F47, 2)	=C48-D48	=F47-E48
49		34	=$C$11	=ROUND($C$9*F48, 2)	=C49-D49	=F48-E49
50		35	=$C$11	=ROUND($C$9*F49, 2)	=C50-D50	=F49-E50
51		36	=$C$11	=ROUND($C$9*F50, 2)	=C51-D51	=F50-E51
52		37	=$C$11	=ROUND($C$9*F51, 2)	=C52-D52	=F51-E52
53		38	=$C$11	=ROUND($C$9*F52, 2)	=C53-D53	=F52-E53
54		39	=$C$11	=ROUND($C$9*F53, 2)	=C54-D54	=F53-E54
55		40	=$C$11	=ROUND($C$9*F54, 2)	=C55-D55	=F54-E55
56		41	=$C$11	=ROUND($C$9*F55, 2)	=C56-D56	=F55-E56
57		42	=$C$11	=ROUND($C$9*F56, 2)	=C57-D57	=F56-E57
58		43	=$C$11	=ROUND($C$9*F57, 2)	=C58-D58	=F57-E58
59		44	=$C$11	=ROUND($C$9*F58, 2)	=C59-D59	=F58-E59
60		45	=$C$11	=ROUND($C$9*F59, 2)	=C60-D60	=F59-E60
61		46	=$C$11	=ROUND($C$9*F60, 2)	=C61-D61	=F60-E61
62		47	=$C$11	=ROUND($C$9*F61, 2)	=C62-D62	=F61-E62
63		48	=$C$11	=ROUND($C$9*F62, 2)	=C63-D63	=F62-E63
64		49	=$C$11	=ROUND($C$9*F63, 2)	=C64-D64	=F63-E64
65		50	=$C$11	=ROUND($C$9*F64, 2)	=C65-D65	=F64-E65
66		51	=$C$11	=ROUND($C$9*F65, 2)	=C66-D66	=F65-E66
67		52	=$C$11	=ROUND($C$9*F66, 2)	=C67-D67	=F66-E67
68		53	=$C$11	=ROUND($C$9*F67, 2)	=C68-D68	=F67-E68
69		54	=$C$11	=ROUND($C$9*F68, 2)	=C69-D69	=F68-E69
70		55	=$C$11	=ROUND($C$9*F69, 2)	=C70-D70	=F69-E70
71		56	=$C$11	=ROUND($C$9*F70, 2)	=C71-D71	=F70-E71
72		57	=$C$11	=ROUND($C$9*F71, 2)	=C72-D72	=F71-E72
73		58	=$C$11	=ROUND($C$9*F72, 2)	=C73-D73	=F72-E73
74		59	=$C$11	=ROUND($C$9*F73, 2)	=C74-D74	=F73-E74
75		60	=$C$11-0.06	=ROUND($C$9*F74, 2)	=C75-D75	=F74-E75

MARKS | DO NOT WRITE IN THIS MARGIN

9. (continued)

The maximum monthly repayment allowed by the lender is £550.

Esme chooses to reduce the term of her mortgage by increasing her monthly repayments to the maximum amount.

Open the 'Increased payments' worksheet.

(c) (i) Complete the 'Increased payments schedule' for the reduced term and calculate the final repayment amount. 2

(ii) Determine how much money this would save Esme over the term of her mortgage. 1

27,250.74 − 26,827.19 = £423.55

Print the 'Mortgage' worksheet in value view and in formula view.

Print the 'Increased payments' worksheet in value view and in formula view.

[Turn over

	A	B	C	D	E	F
1		Name:	H WALLACE			
2		SCN:				
3		Centre name:	WORKED SOLUTIONS			
4						
5		Increased payments schedule				
6						
7		Mortgage amount	£ 25,000.00		VALUE VIEW.	
8		Annual effective interest rate	3.50%			
9		Monthly effective interest rate	0.29%			
10		Level monthly repayment	£ 550.00			
11		Final repayment	£ 427.19			
12						
13		Time (months)	Repayment (£)	Interest content of repayment (£)	Capital content of repayment (£)	Mortgage outstanding (£)
14		0				25,000.00
15		1	550.00	71.77	478.23	24,521.77
16		2	550.00	70.40	479.60	24,042.17
17		3	550.00	69.02	480.98	23,561.19
18		4	550.00	67.64	482.36	23,078.83
19		5	550.00	66.26	483.74	22,595.09
20		6	550.00	64.87	485.13	22,109.96
21		7	550.00	63.48	486.52	21,623.44
22		8	550.00	62.08	487.92	21,135.52
23		9	550.00	60.68	489.32	20,646.20
24		10	550.00	59.27	490.73	20,155.47
25		11	550.00	57.86	492.14	19,663.33
26		12	550.00	56.45	493.55	19,169.78
27		13	550.00	55.03	494.97	18,674.81
28		14	550.00	53.61	496.39	18,178.42
29		15	550.00	52.19	497.81	17,680.61
30		16	550.00	50.76	499.24	17,181.37
31		17	550.00	49.33	500.67	16,680.70
32		18	550.00	47.89	502.11	16,178.59
33		19	550.00	46.45	503.55	15,675.04
34		20	550.00	45.00	505.00	15,170.04
35		21	550.00	43.55	506.45	14,663.59
36		22	550.00	42.10	507.90	14,155.69
37		23	550.00	40.64	509.36	13,646.33
38		24	550.00	39.18	510.82	13,135.51
39		25	550.00	37.71	512.29	12,623.22
40		26	550.00	36.24	513.76	12,109.46
41		27	550.00	34.77	515.23	11,594.23
42		28	550.00	33.29	516.71	11,077.52
43		29	550.00	31.80	518.20	10,559.32
44		30	550.00	30.31	519.69	10,039.63
45		31	550.00	28.82	521.18	9,518.45

	A	B	C	D	E	F
1		Name:	H WALLACE			
2		SCN:				
3		Centre name:	WORKED SOLUTIONS			
4						
46		32	550.00	27.33	522.67	8,995.78
47		33	550.00	25.83	524.17	8,471.61
48		34	550.00	24.32	525.68	7,945.93
49		35	550.00	22.81	527.19	7,418.74
50		36	550.00	21.30	528.70	6,890.04
51		37	550.00	19.78	530.22	6,359.82
52		38	550.00	18.26	531.74	5,828.08
53		39	550.00	16.73	533.27	5,294.81
54		40	550.00	15.20	534.80	4,760.01
55		41	550.00	13.67	536.33	4,223.68
56		42	550.00	12.13	537.87	3,685.81
57		43	550.00	10.58	539.42	3,146.39
58		44	550.00	9.03	540.97	2,605.42
59		45	550.00	7.48	542.52	2,062.90
60		46	550.00	5.92	544.08	1,518.82
61		47	550.00	4.36	545.64	973.18
62		48	550.00	2.79	547.21	425.97
63		49	427.19	1.22	425.97	- 0.00
64						
65		Total Repayment	26827.19			

Question 9(c)(i)

	A	B	C	D	E	F
1		Name:	H WALLACE			
2		SCN:				
3		Centre name:	WORKED SOLUTIONS			
4						
5		Increased payments schedule				
6						
7		Mortgage amount	25000			
8		Annual effective interest rate	0.035		FORMULAE VIEW.	
9		Monthly effective interest rate	=(1+C8)^(1/12)-1			
10		Level monthly repayment	550			
11		Final repayment	=C63			
12						
13		Time (months)	Repayment (£)	Interest content of repayment (£)	Capital content of repayment (£)	Mortgage outstanding (£)
14		0				25000
15		1	=$C$10	=ROUND($C$9*F14, 2)	=C15-D15	=F14-E15
16		2	=$C$10	=ROUND($C$9*F15, 2)	=C16-D16	=F15-E16
17		3	=$C$10	=ROUND($C$9*F16, 2)	=C17-D17	=F16-E17
18		4	=$C$10	=ROUND($C$9*F17, 2)	=C18-D18	=F17-E18
19		5	=$C$10	=ROUND($C$9*F18, 2)	=C19-D19	=F18-E19
20		6	=$C$10	=ROUND($C$9*F19, 2)	=C20-D20	=F19-E20
21		7	=$C$10	=ROUND($C$9*F20, 2)	=C21-D21	=F20-E21
22		8	=$C$10	=ROUND($C$9*F21, 2)	=C22-D22	=F21-E22
23		9	=$C$10	=ROUND($C$9*F22, 2)	=C23-D23	=F22-E23
24		10	=$C$10	=ROUND($C$9*F23, 2)	=C24-D24	=F23-E24
25		11	=$C$10	=ROUND($C$9*F24, 2)	=C25-D25	=F24-E25
26		12	=$C$10	=ROUND($C$9*F25, 2)	=C26-D26	=F25-E26
27		13	=$C$10	=ROUND($C$9*F26, 2)	=C27-D27	=F26-E27
28		14	=$C$10	=ROUND($C$9*F27, 2)	=C28-D28	=F27-E28
29		15	=$C$10	=ROUND($C$9*F28, 2)	=C29-D29	=F28-E29
30		16	=$C$10	=ROUND($C$9*F29, 2)	=C30-D30	=F29-E30
31		17	=$C$10	=ROUND($C$9*F30, 2)	=C31-D31	=F30-E31
32		18	=$C$10	=ROUND($C$9*F31, 2)	=C32-D32	=F31-E32
33		19	=$C$10	=ROUND($C$9*F32, 2)	=C33-D33	=F32-E33
34		20	=$C$10	=ROUND($C$9*F33, 2)	=C34-D34	=F33-E34
35		21	=$C$10	=ROUND($C$9*F34, 2)	=C35-D35	=F34-E35
36		22	=$C$10	=ROUND($C$9*F35, 2)	=C36-D36	=F35-E36
37		23	=$C$10	=ROUND($C$9*F36, 2)	=C37-D37	=F36-E37
38		24	=$C$10	=ROUND($C$9*F37, 2)	=C38-D38	=F37-E38

Question 9(c)(i)

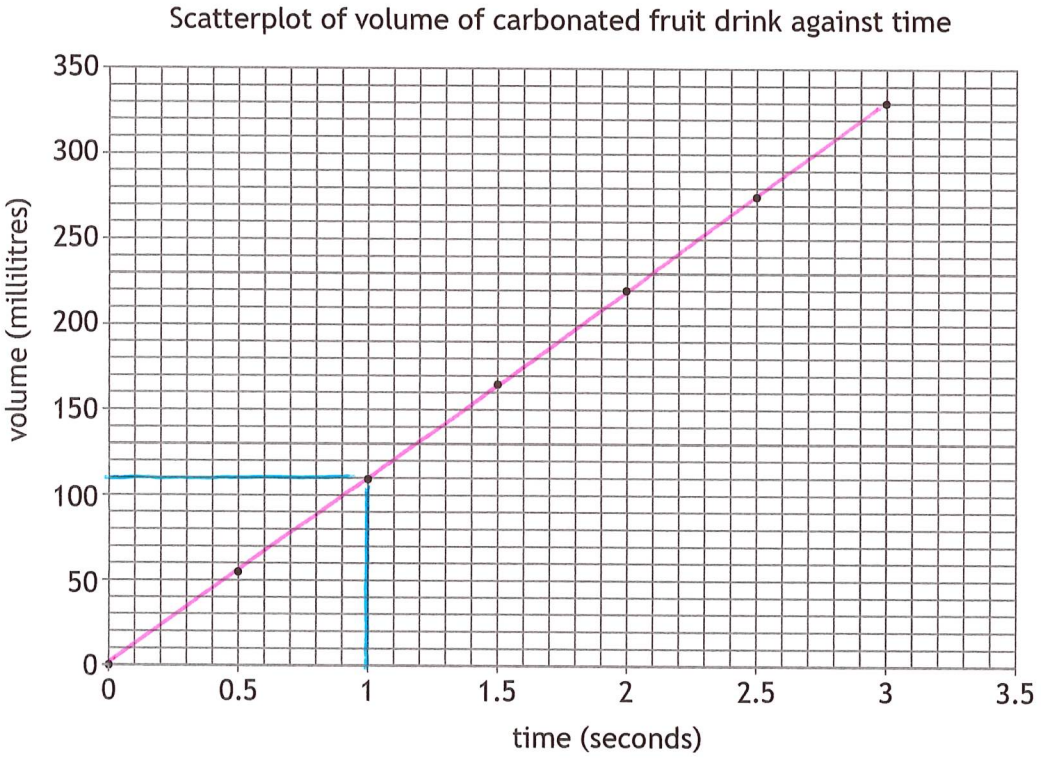
	A	B	C	D	E	F
1		Name:	H WALLACE			
2		SCN:				
3		Centre name:	WORKED SOLUTIONS			
4						
39		25	=$C$10	=ROUND($C$9*F38, 2)	=C39-D39	=F38-E39
40		26	=$C$10	=ROUND($C$9*F39, 2)	=C40-D40	=F39-E40
41		27	=$C$10	=ROUND($C$9*F40, 2)	=C41-D41	=F40-E41
42		28	=$C$10	=ROUND($C$9*F41, 2)	=C42-D42	=F41-E42
43		29	=$C$10	=ROUND($C$9*F42, 2)	=C43-D43	=F42-E43
44		30	=$C$10	=ROUND($C$9*F43, 2)	=C44-D44	=F43-E44
45		31	=$C$10	=ROUND($C$9*F44, 2)	=C45-D45	=F44-E45
46		32	=$C$10	=ROUND($C$9*F45, 2)	=C46-D46	=F45-E46
47		33	=$C$10	=ROUND($C$9*F46, 2)	=C47-D47	=F46-E47
48		34	=$C$10	=ROUND($C$9*F47, 2)	=C48-D48	=F47-E48
49		35	=$C$10	=ROUND($C$9*F48, 2)	=C49-D49	=F48-E49
50		36	=$C$10	=ROUND($C$9*F49, 2)	=C50-D50	=F49-E50
51		37	=$C$10	=ROUND($C$9*F50, 2)	=C51-D51	=F50-E51
52		38	=$C$10	=ROUND($C$9*F51, 2)	=C52-D52	=F51-E52
53		39	=$C$10	=ROUND($C$9*F52, 2)	=C53-D53	=F52-E53
54		40	=$C$10	=ROUND($C$9*F53, 2)	=C54-D54	=F53-E54
55		41	=$C$10	=ROUND($C$9*F54, 2)	=C55-D55	=F54-E55
56		42	=$C$10	=ROUND($C$9*F55, 2)	=C56-D56	=F55-E56
57		43	=$C$10	=ROUND($C$9*F56, 2)	=C57-D57	=F56-E57
58		44	=$C$10	=ROUND($C$9*F57, 2)	=C58-D58	=F57-E58
59		45	=$C$10	=ROUND($C$9*F58, 2)	=C59-D59	=F58-E59
60		46	=$C$10	=ROUND($C$9*F59, 2)	=C60-D60	=F59-E60
61		47	=$C$10	=ROUND($C$9*F60, 2)	=C61-D61	=F60-E61
62		48	=$C$10	=ROUND($C$9*F61, 2)	=C62-D62	=F61-E62
63		49	=$C$10-122.81	=ROUND($C$9*F62, 2)	=C63-D63	=F62-E63
64						
65		Total Repayment	=SUM(C14:C63)			

MARKS | DO NOT WRITE IN THIS MARGIN

10. A factory fills cans with a carbonated fruit drink.

The cans produced have a volume of 330 millilitres.

The graph below shows the relationship between time, in seconds, and volume of carbonated fruit drink, in millilitres, as a can is filled.



(a) State the type of relationship modelled in the graph. 1

Positive linear relationship.

(b) Determine the rate at which each can is filled with carbonated fruit drink.

Your answer must include appropriate units. 2

From the graph, each can is filled at a steady rate of 110 ml/s.

10. (continued)

The factory can only fill the cans when there are staff present.

The machines in the factory can fill 5 cans at the same time.

(c) Estimate how many cans the factory can fill in one week.

State any assumptions you have made. **3**

Assume factory is open 8am – 5pm, Monday to Friday

9 hours per day x 5 = 45 hours

45 hrs x 60 mins = 2700 minutes.

1 can (330ml) will take 3 seconds to fill

5 cans filled in 3 seconds (x 20)

100 cans filled in 1 minute

Total cans ≈ 2700 x 100 ≈ 270,000

[END OF QUESTION PAPER]