Applications of Mathematics (Higher): question paper

Candidate evidence

Candidate 1 evidence

Question 1(a)

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**

$$\left(1+\frac{29.9}{100}\right)^{\frac{1}{12}}-1\times 100$$

$$= 2.20\%.$$

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

Candidate 2 evidence

Question 1(a)

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**

29.9% ÷ 12 = 2.5%

4000 × 1.025 = 4100

Candidate 3 evidence

Question 1(b)

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	100.00	350.00	3650.00
2	250.00	91.25	341.25	3308.75

Candidate 4 evidence

Question 1(a) and (b)

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

$(0.299)^{\frac{1}{12}}$
$= 0.90\%$

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

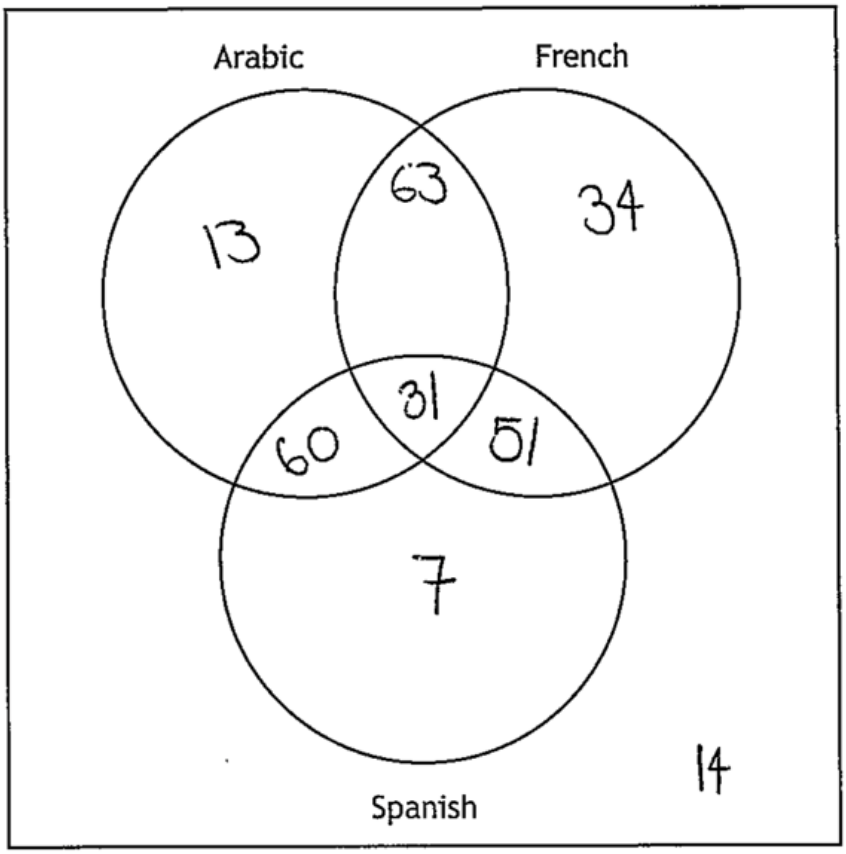
Time (months)	Repayment (£)	Interest content of repayment (£)	Capital content of repayment (£)	Loan outstanding (£)
0				4000.00
1	250.00	36	214	3786
2	250.00	34.07	215.93	3570.07

Space for working if required

Candidate 5 evidence

Question 2(a)

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



Question 2(b)

(b) A student is selected at random.

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

$$\frac{60}{273} = 0.2197\ldots$$

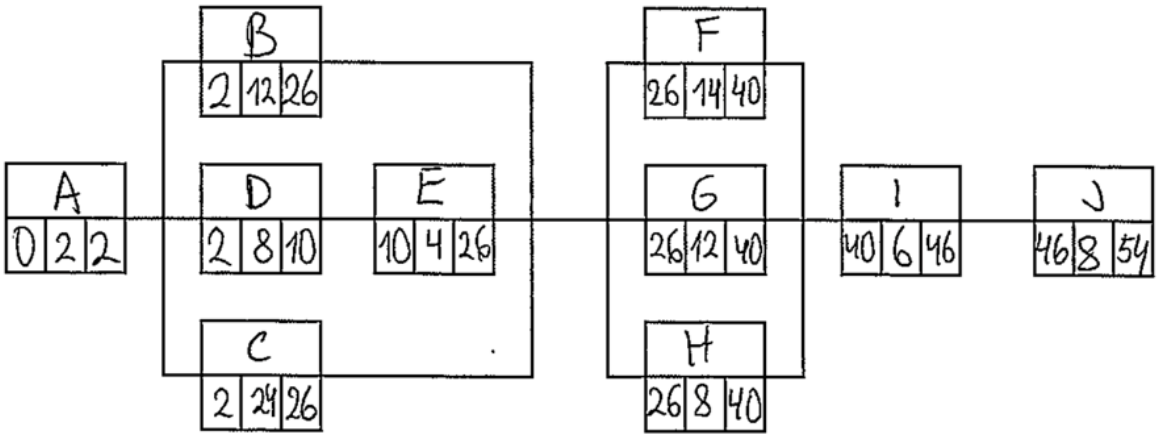
$$= 0.2$$

Candidate 6 evidence

Question 3(a)

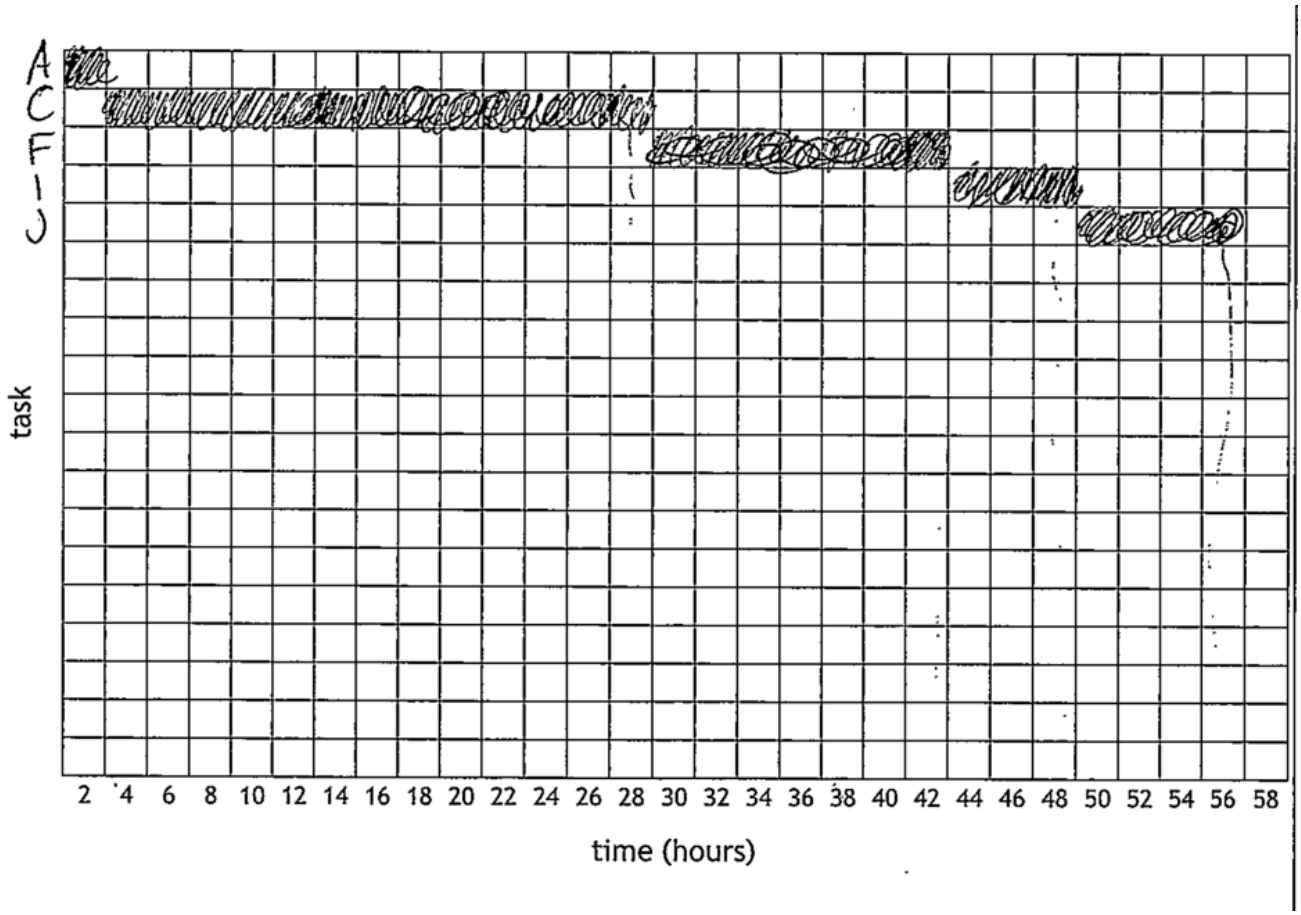
(a) Complete the PERT chart showing the earliest start time and the latest completion time for each task.

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



Candidate 7 evidence

Question 3(b)

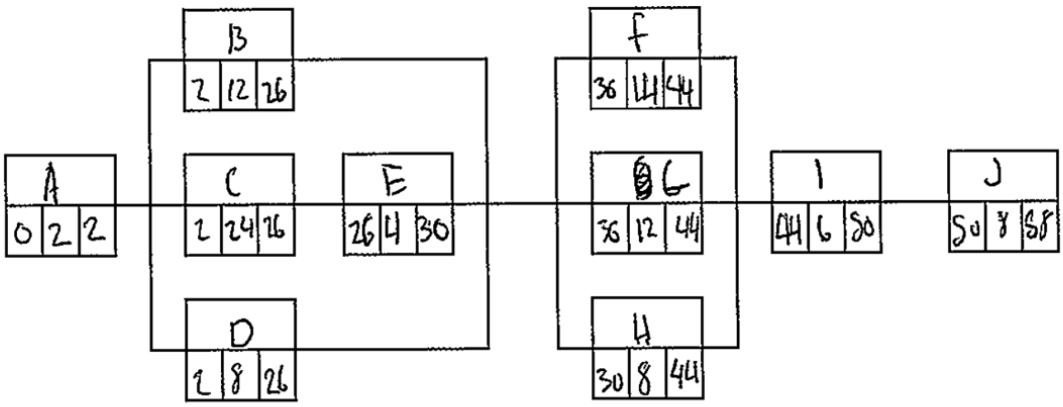


Candidate 8 evidence

Question 3(a)

(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*.)

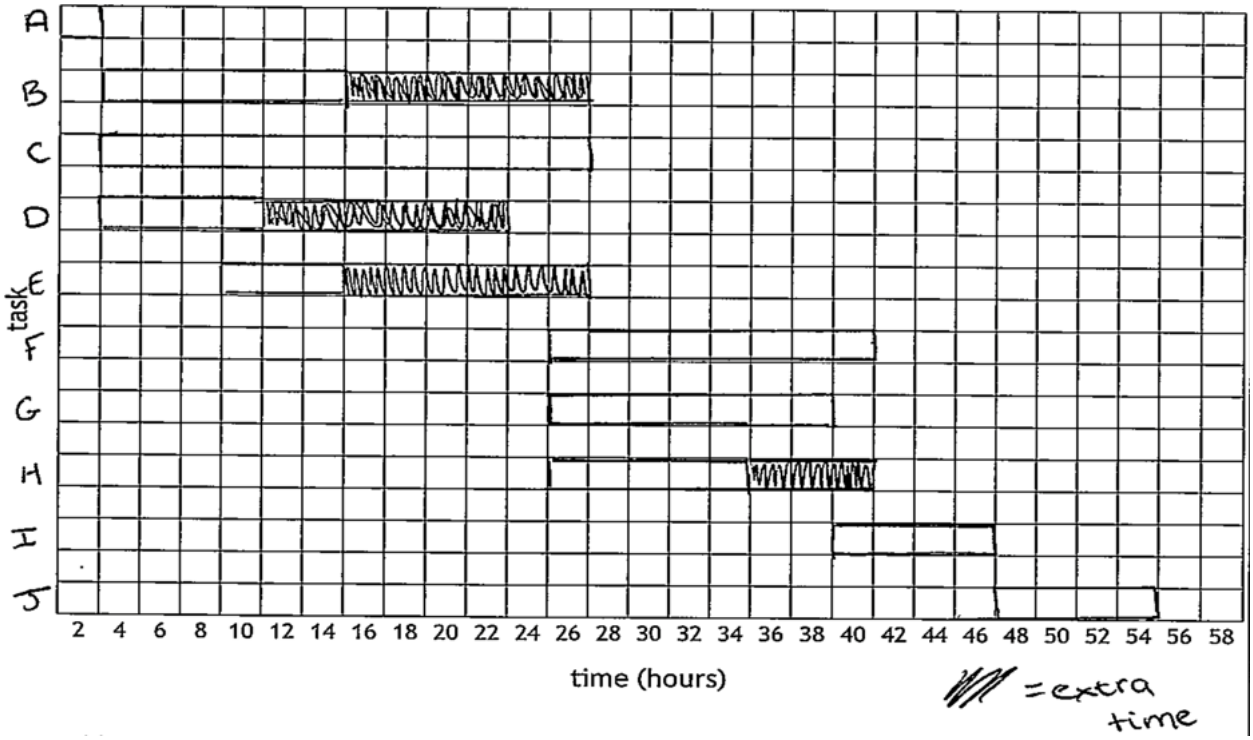


Candidate 9 evidence

Question 3(b)

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

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



Candidate 10 evidence

Question 3(d)

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**

6 hours.

Candidate 11 evidence

Question 4(c)

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

as the CO_2 concentration is lower than 500ppm. 187.30ppm < 500ppm.

Candidate 12 evidence

Question 4(c)

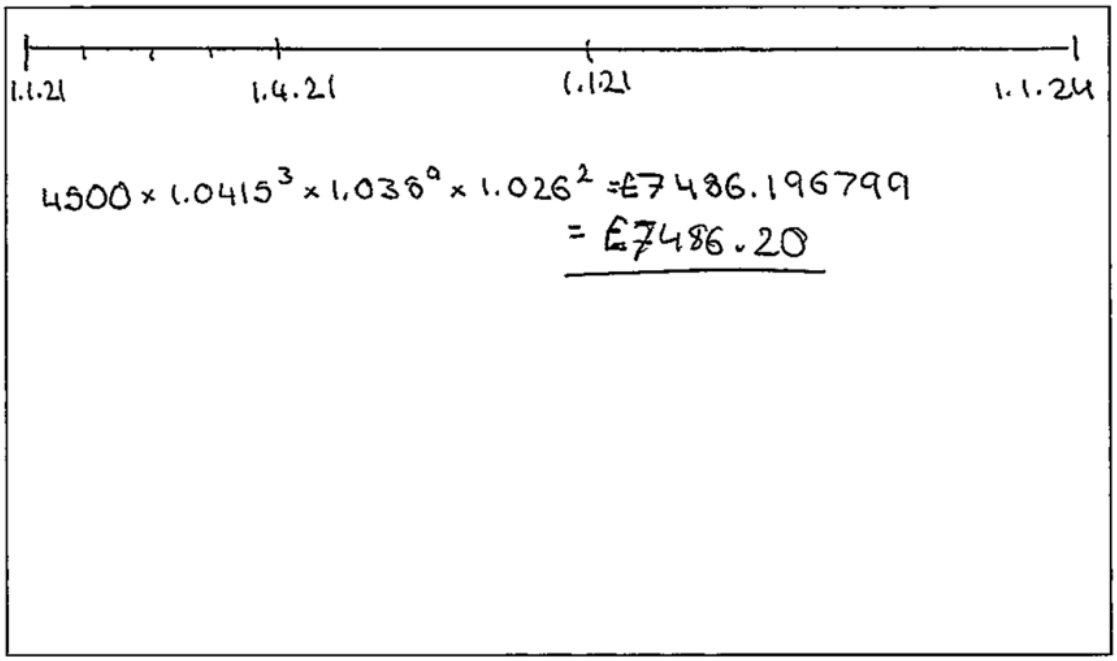
(c) Explain whether the large Dracaena plants are effective at obtaining very good indoor air quality in the showroom. 1

While the plant does decrease CO_2 Levels, the levels of air quality cannot be described as very good as they are ~~[illegible]~~ more than 800ppm.

Candidate 13 evidence

Question 5(a)

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



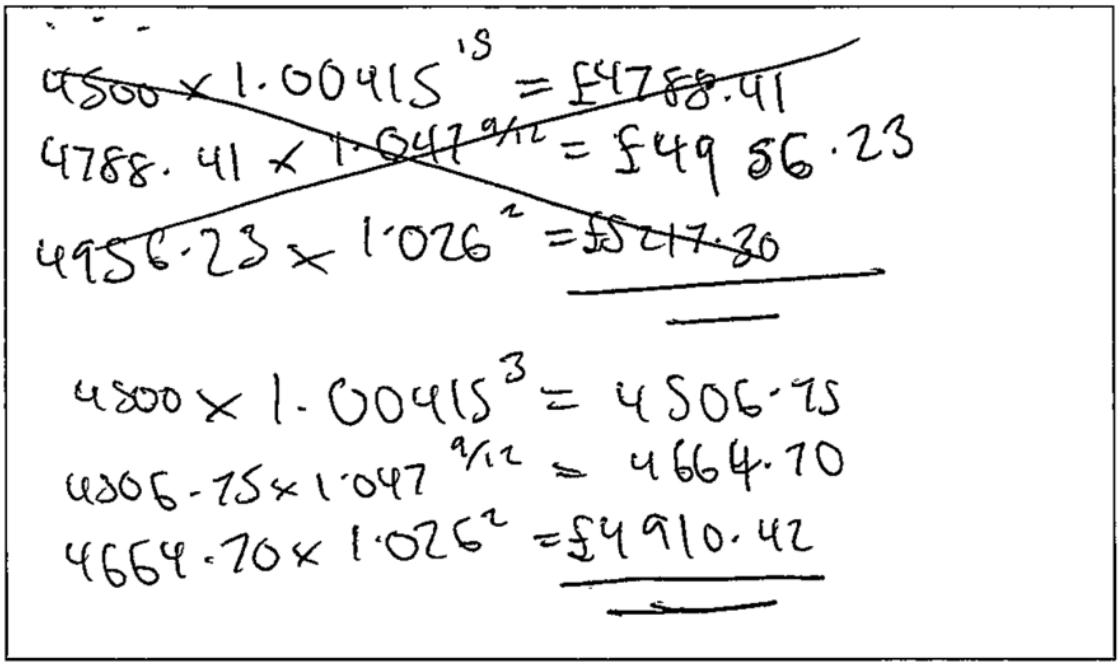
$4500 \times 1.0415^3 \times 1.038^9 \times 1.026^2 = £7486.196799$

$= £7486.20$

Candidate 14 evidence

Question 5(a)

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



Candidate 15 evidence

Question 6(a)(i)

(i)

Statistical software output:

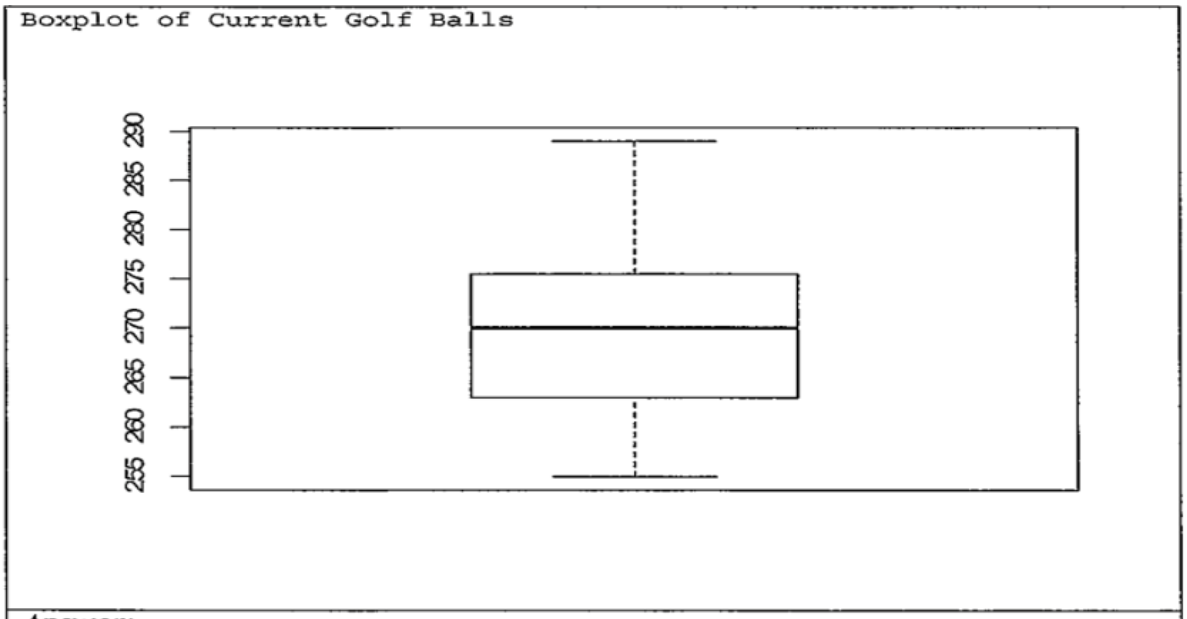
```
> summary(current)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  255.0   263.0   270.0   270.3   275.2   289.0
> summary(new)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  250.0   262.0   265.0   267.5   274.5   289.0
>
```

Answer:

	Measure of location (metres)	Measure of spread (metres)
Current golf ball	270.3	255-289
New golf ball	267.5	250-289

Candidate 16 evidence

Question 6(a)(i)



Answer:

	Measure of location (metres)	Measure of spread (metres)
Current golf ball	270	40
New golf ball	265	40

Candidate 17 evidence

Question 6(a)

(a) (i)

Statistical software output:

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

Candidate 18 evidence

Question 6(a)(ii)

(ii)

Answer:
The current golf ball has travelled more in the measure of location as 270.275>267.5.
The new golf ball has travelled more in the measure of spread as 9.896904>8.752985.

Candidate 19 evidence

Question 6(a)(ii)

(ii)

Answer-The current ball on average reaches further distances than the new ball as seen from the difference in the mean and the median. The new ball also is less consistent on the distance travelled, and there is wider range of distances.

Candidate 20 evidence

Question 6(b)

(b)

Answer:

Null hypothesis:

H0: there is no difference in the distances travelled (in metres) between the current golf balls and the new golf balls.

Alternative hypothesis:

H1: there is a difference in the distances travelled (in metres) between the current golf balls and the new golf balls.

Candidate 21 evidence

Question 6(b)

(b)

Answer:

Null hypothesis: There is no difference between the two types of balls in the distance travelled

Alternative hypothesis: New ball travels further distances than the current ball

Candidate 22 evidence

Question 6(c)(ii)

(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*

Candidate 23 evidence

Question 6(c)(i)(ii)

(c) (i)

Answer:
Paired t-test

(ii)

Statistical software output:

```
> t.test(current, new, paired=TRUE)

        Paired t-test

data:  current and new
t = 1.277, df = 39, p-value = 0.2092
alternative hypothesis: true mean difference is not equal t
o 0
95 percent confidence interval:
 -1.620536  7.170536
sample estimates:
mean difference
          2.775
```

Answer:

p-value = *0.2092*

Candidate 24 evidence

Question 6(c)(iii)

(iii)

Answer: The p-value is greater and bigger than 0.05 which means we do not reject the null hypothesis.
And that there is no significant difference between the current and the new type of balls and the distance they travel.

Candidate 25 evidence

Question 6(c)(iii)

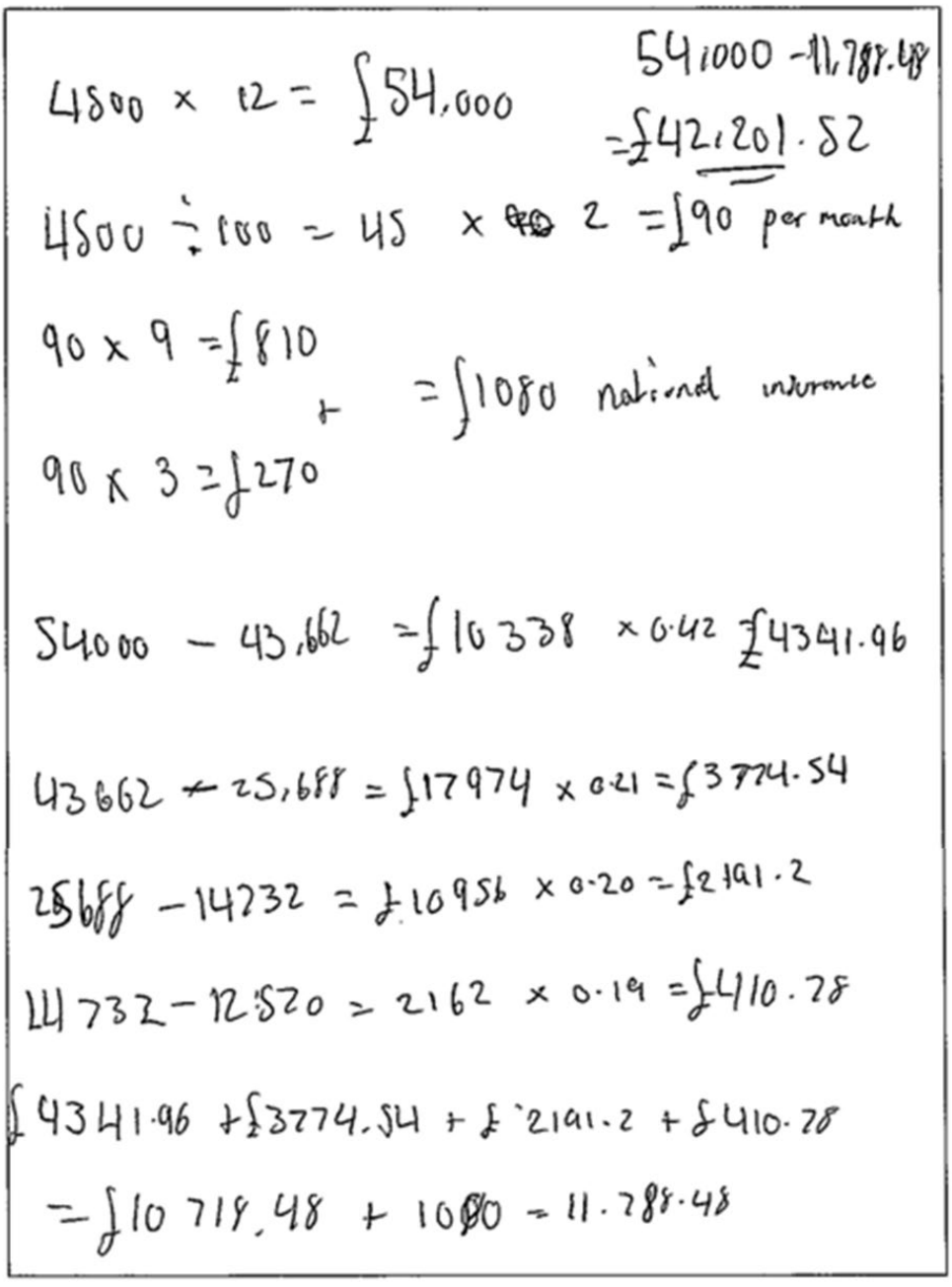
(iii)

Answer:
As the p-value is greater than 0.05 the null hypothesis can be rejected

Candidate 26 evidence

Question 7(a)

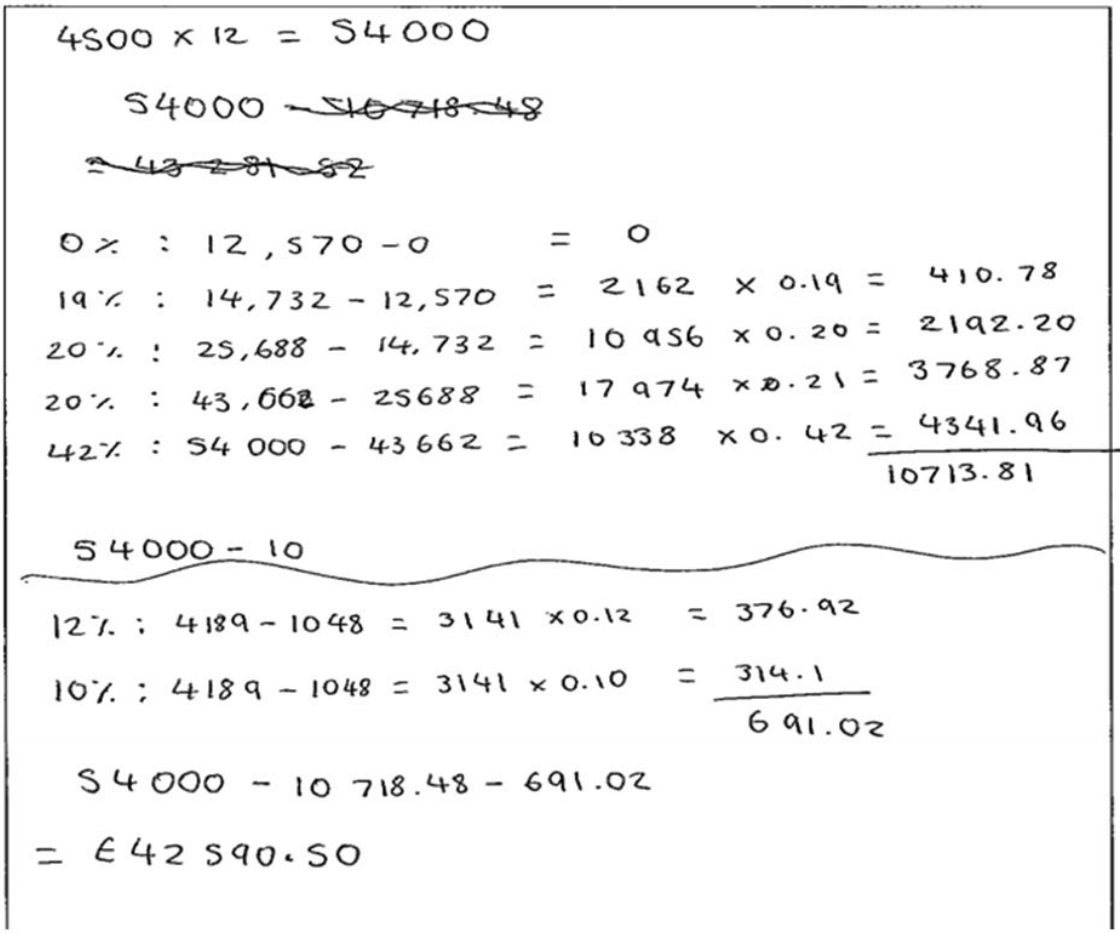
(a) Calculate Tom's **net annual salary** for the 2023/24 tax year, after all deductions including National Insurance.



Candidate 27 evidence

Question 7(a)

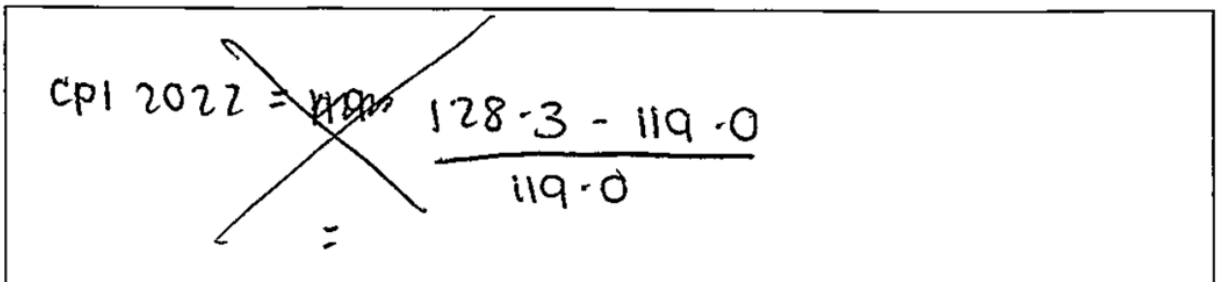
(a) Calculate Tom's **net annual salary** for the 2023/24 tax year, after all deductions including National Insurance.



Candidate 28 evidence

Question 7(b)

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



Candidate 29 evidence

Question 7(b)

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

$\frac{119 \cdot 0}{4200} = 0 \cdot 0283 = 2 \cdot 83\%$.

$\frac{128 \cdot 3}{4500} = 0 \cdot 02851 = 2 \cdot 85\%$.

Yes, Tom's gross monthly salary has increased in line with the CPI as $2 \cdot 85\% > 2 \cdot 83\%$.

Candidate 30 evidence

Question 8(b)(i) and (ii)

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

(i) only control measure 1

15 000 + 2437S

= 39 37S

39 37S x 0.1 = £3939.50

(ii) only control measure 2.

16 000 + 2437S

= 40 37S

40 37S x 0.2S = £10 093.75

Candidate 31 evidence

Question 9(a)

	Mortgage amount	£ 25,000.00			
	Annual effective interest rate	3.50%			
	Monthly effective interest rate	0.29%			
	Repayment (months)	60			
	Level monthly repayment	£ 454.18			
	Final repayment	£ 454.12			
	Time (months)	Repayment (£)	Interest content of repayment (£)	Capital content of repayment (£)	Mortgage outstanding (£)
	0				25,000.00
	1	454.18	71.77	382.41	24,617.59
	2	454.18	70.67	383.51	24,234.08
	3	454.18	69.57	384.61	23,849.47

Mortgage Schedule				
Mortgage amount	25000			
Annual effective interest rate	0.035			
Monthly effective interest rate	=(1+C8)^(1/12)-1			
Repayment (months)	60			
Level monthly repayment	454.18			
Final repayment	=C75			
ıe ths)	Repayment (£)	Interest content of repayment (£)	Capital content repayment (£)	Mortgage outstanding (£)
				25000
	=$C$11	=ROUND(F15*$C$9,2)	=C16-D16	=F15-E16
	=$C$11	=ROUND(F16*$C$9,2)	=C17-D17	=F16-E17
	=$C$11	=ROUND(F17*$C$9,2)	=C18-D18	=F17-E18
	=$C$11	=ROUND(F18*$C$9,2)	=C19-D19	=F18-E19
	=$C$11	=ROUND(F19*$C$9,2)	=C20-D20	=F19-E20
	=$C$11	=ROUND(F20*$C$9,2)	=C21-D21	=F20-E21
				=F21-E22

Candidate 32 evidence

Question 9(a)

Mortgage Schedule				
Mortgage amount	£ 25,000.00			
Annual effective interest rate	3.50%			
Monthly effective interest rate	0.29%			
Repayment (months)	60			
Level monthly repayment	£ 416.67			
Final repayment	£ 416.67			
Time (months)	Repayment (£)	Interest content of repayment (£)	Capital content of repayment (£)	Mortgage outstanding (£)
0				25,000.00
1	416.67	72.92	343.75	24,583.33
2	416.67	71.70	344.97	24,166.67
3	416.67	70.49	346.18	23,750.00

Mortgage Schedule				
Mortgage amount	25000			
Annual effective interest rate	0.035			
Monthly effective interest rate	=C8*1/12			
Repayment (months)	60			
Level monthly repayment	=C7/C10			
Final repayment	=F74			
Time months)	Repayment (£)	Interest content repayment (£)	Capital content of repayment (£)	Mortgage outstanding (£)
				25000
	=$C$11	=(F15*$C$9)	=C16-D16	=F15-C16
	=$C$11	=(F16*$C$9)	=C17-D17	=F16-C17
	=$C$11	=(F17*$C$9)	=C18-D18	=F17-C18

Candidate 33 evidence

Question 9(b)(i)

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

reduces the amount you pay each year if payed on time

Candidate 34 evidence

Question 9(b)(i)

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

it may cover more damages?

Candidate 35 evidence

Question 9(b)(i)

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

Incase you need to use it, incase you make a claim

Candidate 36 evidence

Question 9(b)(ii)

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

Her Insurance may go up as a result of making a claim.

Candidate 37 evidence

Question 10(b)

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

Your answer must include appropriate units.

50mm per 0.5 Seconds

Candidate 38 evidence

Question 10(b)

(b) Determine the rate at which each can is filled with carbonated fruit drink.
Your answer must include appropriate units.

50 millimetres per half second

50mmphs

Candidate 39 evidence

Question 10(c)

(c) Estimate how many cans the factory can fill in one week.
State any assumptions you have made. 3

3 seconds to fill a can
Staff work 5 days per week for 9 hrs

9 × 60 = 540 minutes × 60 = 32,400 seconds
32400 ÷ 3 = 10800
10,800 × 5 = 54,000 cans per day
54,000 × 5 = 270,000 cans per week

Candidate 40 evidence

Question 10(c)

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

State any assumptions you have made. 3

assumptions:

Staff work 9-5 monday to friday. Thy also have a one hour lunch break.

cans are 330 militres each

5 are filled at a time

it takes 3 seconds to fill a can

~~3 x 5 x 5 x 7 = 525 cans per week~~

330 x 3 x 5 x 7 x 5 = 173250 cans per week.