Mathematics
Paper 4

Numbers

QUESTIONS

1   Dhanu has a model railway.

   (a) He has a train that consists of a locomotive and 4 coaches.
The mass of the locomotive is 87 g and the mass of each coach is 52 g.

      (i)   Work out the total mass of the train.

.... g [2]

      (ii) Work out the mass of the locomotive as a percentage of the total mass of the train.

.... % [1]

   (b) The train is 61 cm long and travels at a speed of 18 cm/s.
It takes 4 seconds for the whole of the train to cross a bridge.

Calculate the length of the bridge.

.... cm [2]

   (c) A new locomotive costs $64.

Calculate the cost of the locomotive in rupees when the exchange rate is 1 rupee = $0.0154 .
Give your answer correct to the nearest 10 rupees.

.... rupees [2]

(d) The cost of a railway magazine increases by 12.5% to $2.70 .

Calculate the cost of the magazine before this increase.

$ .... [2]

(e) Dhanu plays with his model railway from 06 50 to 11 15.
He then rides his bicycle for 3 hours.

Find the ratio   time playing with model railway : time riding bicycle.
Give your answer in its simplest form.

.... : .... [3]

(f) The value of Dhanu's model railway is $550.
This value increases exponentially at a rate of r% per year.
At the end of 5 years the value will be $736.

Calculate the value of r.

$r =$ .... [3]

3 **(a)** Manjeet uses 220 litres of water each day.
She reduces the amount of water she uses by 15%.

Calculate the number of litres of water she now uses each day.

.... litres [2]

7.

(c) Find the nth term of each sequence.

(i)   4   2   0   −2   −4   …

.... [2]

(ii)   1   7   17   31   49   …

.... [2]

9   This year, 40 students have each travelled by one or more of plane (P), train (T) or boat (B).
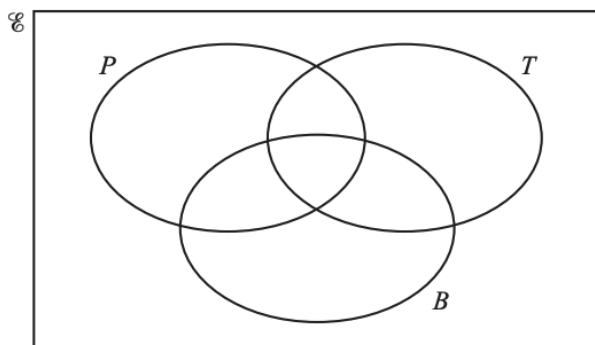
   7 have travelled only by plane.
  11 have travelled only by train.
   9 have travelled only by boat.

$n(P \cap T) = 8$
$n(B \cap T) = 3$
$n(B \cap P) = 6$

(a) Complete the Venn diagram. [3]

(b) Find $n\big((P \cup B)'\big)$.

.... [1]

(c) Use set notation to complete the statement.

$$(P \cup T \cup B)' = \text{..........................}$$ [1]

4

10 $f(x) = 4x - 1$ $g(x) = x^2$ $h(x) = 3^{-x}$

(c) Find the value of $hh(1)$, correct to 4 significant figures.

.... [3]

1 **(a)** In 2018, Gretal earned $32 000.

    (i) She paid tax of 24% on these earnings.

      Work out the amount she paid in tax in 2018.

$ .... [2]

    (ii) In 2019, Gretal's earnings increased by 7%.

      Work out her earnings in 2019.

$ .... [2]

(b) Gretal invests $5000 at a rate of 2% per year compound interest.

Calculate the value of her investment at the end of 3 years.

$ .... [2]

(c) One month, Gretal spent a total of $360 on presents.
She spent $\frac{1}{5}$ of this total on presents for her parents.
She spent $\frac{2}{3}$ of the remaining money on presents for her friends.
She spent the rest of the money on presents for her sisters.

Calculate the percentage of the $360 that she spent on presents for her sisters.

.... % [4]

(d) Arjun earned $36 515 in 2019.
This was an increase of 9% on his earnings in 2018.

Work out his earnings in 2018.

$ .... [2]

(e) Arjun and Gretal each pay rent.

In 2018, the ratio of the amount each paid in rent was Arjun : Gretal = 5 : 7.
In 2019, the ratio of the amount each paid in rent was Arjun : Gretal = 9 : 13.

Arjun paid the same amount of rent in both 2018 and 2019.
Gretal paid $290 more rent in 2019 than she did in 2018.

Work out the amount Arjun paid in rent in 2019.

$ .... [4]
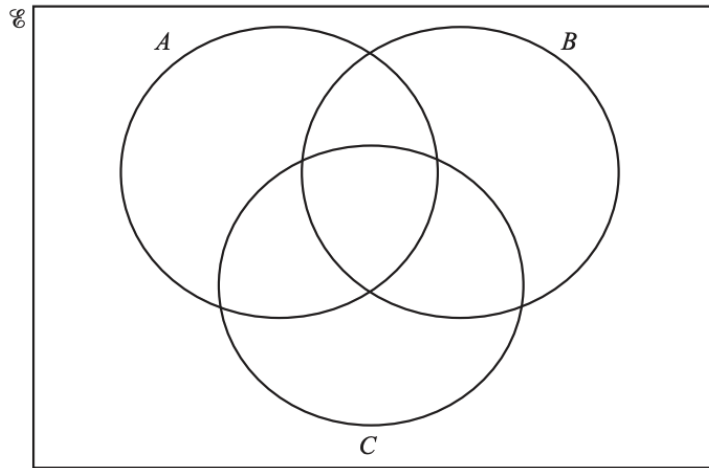
5 x is an integer.

$\mathcal{E} = \{x : 41 \leqslant x \leqslant 50\}$

$A = \{x : x \text{ is an odd number}\}$

$B = \{x : x \text{ is a multiple of 3}\}$

$C = \{x : x \text{ is a prime number}\}$

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

[3]

(b) List the elements of

(i) $A \cap C$,

.... [1]

(ii) $(B \cup C)'$.

.... [1]

(c) Find $n(A \cap B \cap C)$.

.... [1]

1   (a)   (i)   Divide $24 in the ratio 7 : 5.

$ .... , $ .... [2]

(ii)   Write $24.60 as a fraction of $2870.
Give your answer in its lowest terms.

.... [2]

(iii)   Write $1.92 as a percentage of $1.60 .

.... % [1]

(b)   In a sale the original prices are reduced by 15%.

(i)   Calculate the sale price of a book that has an original price of $12.

$ .... [2]

(ii)   Calculate the original price of a jacket that has a sale price of $38.25 .

$ .... [2]

(c) **(i)** Dean invests $500 for 10 years at a rate of 1.7% per year simple interest.

Calculate the total interest earned during the 10 years.

$ .... [2]

(ii) Ollie invests $200 at a rate of 0.0035% **per day** compound interest.

Calculate the value of Ollie's investment at the end of 1 year.
[1 year = 365 days.]

$ .... [2]

(iii) Edna invests $500 at a rate of r% per year compound interest.
At the end of 6 years, the value of Edna's investment is $559.78 .

Find the value of r.

$r =$ .... [3]

1 (a)

```
┌─────────────────────────┐
│     Campsite fees       │
│      (per day)          │
│                         │
│  Tent  ............ $15.00  │
│  Caravan  ....... $25.00   │
└─────────────────────────┘
```

The sign shows the fees charged at a campsite.
Today there are 54 tents and 18 caravans on the site.

Calculate the fees charged today.

$ .... [2]

(b) In September the total income at the campsite was $37 054.
This was a decrease of 4.5% on the total income in August.

Calculate the total income in August.

$ .... [2]

(c) The visitors to the campsite today are in the ratio

men : women = 5 : 4   and   women : children = 3 : 7.

(i) Calculate the ratio   men : women : children   in its simplest form.

.... : .... : .... [2]

(ii) Today there are 224 children at the campsite.

Calculate the total number of men and women.

.... [3]

(d) The space allowed for each tent is a rectangle measuring 8 m by 6 m, each correct to the nearest metre.

Calculate the upper bound for the area of the space allowed for each tent.

.... m^2 [2]

(e) The value of the campsite has increased exponentially by 1.5% every year since it opened 30 years ago.

Calculate the value of the campsite now as a percentage of its value 30 years ago.

.... % [2]

2 (a) A plane has 14 First Class seats, 70 Premium seats and 168 Economy seats.

Find the ratio   First Class seats : Premium seats : Economy seats.
Give your answer in its simplest form.

.... : .... : .... [2]

(b) (i) For a morning flight, the costs of tickets are in the ratio

First Class : Premium : Economy $= 14 : 6 : 5$.

The cost of a Premium ticket is $114.

Calculate the cost of a First Class ticket and the cost of an Economy ticket.

First Class $ ....

Economy $ .... [3]

(ii) For an afternoon flight, the cost of a Premium ticket is reduced from $114 to $96.90 .

Calculate the percentage reduction in the cost of a ticket.

.... % [2]

(c) When the local time in Athens is 09 00, the local time in Berlin is 08 00.
A plane leaves Athens at 13 15.
It arrives in Berlin at 15 05 local time.

(i) Find the flight time from Athens to Berlin.
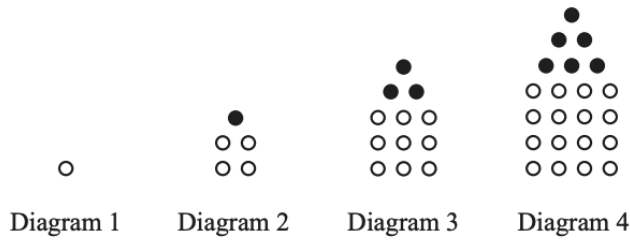
.... h .... min [1]

(ii) The distance the plane flies from Athens to Berlin is 1802 km.

Calculate the average speed of the plane.
Give your answer in kilometres per hour.

.... km/h [2]

7

Diagram 1   Diagram 2   Diagram 3   Diagram 4

These are the first four diagrams of a sequence.
The diagrams are made from white dots and black dots.

(a) Complete the table for Diagram 5 and Diagram 6.

Diagram	1	2	3	4	5	6
Number of white dots	1	4	9	16		
Number of black dots	0	1	3	6		
Total number of dots	1	5	12	22		

[2]

(b) Write an expression, in terms of n, for the number of white dots in Diagram n.

.... [1]

(c) The expression for the total number of dots in Diagram n is $\frac{1}{2}(3n^2 - n)$.

(i) Find the total number of dots in Diagram 8.

.... [1]

(ii) Find an expression for the number of black dots in Diagram n.
Give your answer in its simplest form.

.... [2]

(d) T is the total number of dots used to make **all** of the first n diagrams.

$$T = an^3 + bn^2$$

Find the value of a and the value of b.
You must show all your working.

$a =$ ....

$b =$ .... [5]

8.

(f) Alan invests \$200 at a rate of r% per year compound interest.
After 2 years the value of his investment is \$206.46 .

(i) Show that $r^2 + 200r - 323 = 0$.

[3]

(ii) Solve the equation $r^2 + 200r - 323 = 0$ to find the rate of interest.
Show all your working and give your answer correct to 2 decimal places.

$r =$ .... [3]

1   Karel travelled from London to Johannesburg and then from Johannesburg to Windhoek.

(a) The flight from London to Johannesburg took 11 hours 10 minutes.
     The average speed was 813 km/h.

     Calculate the distance travelled from London to Johannesburg.
     Give your answer correct to the nearest 10 km.

     .... km [3]

(b) The total time for Karel's journey from London to Windhoek was 15 hours 42 minutes.
     The total distance travelled from London to Windhoek was 10 260 km.

     (i)   Calculate the average speed for this journey.

     .... km/h [2]

(ii) The cost of Karel's journey from London to Windhoek was $470.

(a) Calculate the distance travelled per dollar.

.... km per dollar [1]

(b) Calculate the cost per 100 km of this journey.
Give your answer correct to the nearest cent.

$ .... per 100 km [2]

(c) Karel changed $300 into 3891 Namibian dollars.

Complete the statement.

$1 = ... Namibian dollars   [1]

3   **(a)** Beth invests $2000 at a rate of 2% per year compound interest.

   (i) Calculate the value of this investment at the end of 5 years.

$ .... [2]

   (ii) Calculate the overall percentage increase in the value of Beth's investment at the end of 5 years.

.... % [2]

   (iii) Calculate the minimum number of complete years it takes for the value of Beth's investment to increase from $2000 to more than $2500.

.... [3]

   (b) The population of a village decreases exponentially at a rate of 4% each year.
   The population is now 255.

   Calculate the population 16 years ago.

.... [3]

11

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	13	9	5	1			
B	0	7	26	63			
C	$\dfrac{7}{8}$	$\dfrac{8}{16}$	$\dfrac{9}{32}$	$\dfrac{10}{64}$			

(a) Complete the table for the three sequences.

[10]

(b) One term in Sequence C is $\dfrac{p}{q}$.

Write down the next term in Sequence C in terms of p and q.

.... [2]

1 **(a)** The Earth has a surface area of approximately $510\,100\,000\,km^2$.

    (i) Write this surface area in standard form.

        .... km^2 [1]

    (ii) Water covers 70.8% of the Earth's surface.

        Work out the area of the Earth's surface covered by water.

        .... km^2 [2]

(b) The table shows the surface area of some countries and their estimated population in 2017.

Country	Surface area (km^2)	Estimated population in 2017
Brunei	5.77×10^3	433 100
China	9.60×10^6	1 388 000 000
France	6.41×10^5	67 000 000
Maldives	3.00×10^2	374 600

    (i) Find the total surface area of Brunei and the Maldives.

        .... km^2 [1]

    (ii) The ratio   surface area of the Maldives : surface area of China
        can be written in the form $1 : n$.

        Find the value of n.

        $n =$ .... [2]

    (iii) Find the surface area of France as a percentage of the surface area of China.

        .... % [2]

(iv) Find the population density of the Maldives.
[Population density = population ÷ surface area]

..............................people/km^2 [2]

(c) The population of the Earth in 2017 was estimated to be 7.53×10^9.

The population of the Earth in 2000 was estimated to be 6.02×10^9.

(i) Work out the percentage increase in the Earth's estimated population from 2000 to 2017.

.... % [2]

(ii) Assume that the population of the Earth increased exponentially by y% each year for these 17 years.

Find the value of y.

$y =$ .... [3]

11 The table shows the first four terms in sequences A, B, and C.

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	4	9	14	19	24		$5n-1$
B	3	10	29	66	127		n^3+2
C	1	4	16	64	256		4^{n-1}

Complete the table.

[9]

23

1   Amol and Priya deliver 645 parcels in the ratio   Amol : Priya = 11 : 4.

(a)   Calculate the number of parcels Amol delivers.

.... [2]

(b)   Amol drives his truck at an average speed of 50 km/h.
He leaves at 07 00 and arrives at 11 15.

Calculate the distance he drives.

.... km [2]

(c)   Priya drives her van a distance of 54 km.
She leaves at 10 55 and arrives at 12 38.

Calculate her average speed.

.... km/h [3]

(d)   Priya has 50 identical parcels.
Each parcel has a mass of 17 kg, correct to the nearest kilogram.

Find the upper bound for the total mass of the 50 parcels.

.... kg [1]

(e) 67 of the 645 parcels are damaged on the journey.

Calculate the percentage of parcels that are damaged.

.... % [1]

(f) **(i)** 29 parcels each have a value of $68.

By writing each of these numbers correct to 1 significant figure, find an estimate for the total value of these 29 parcels.
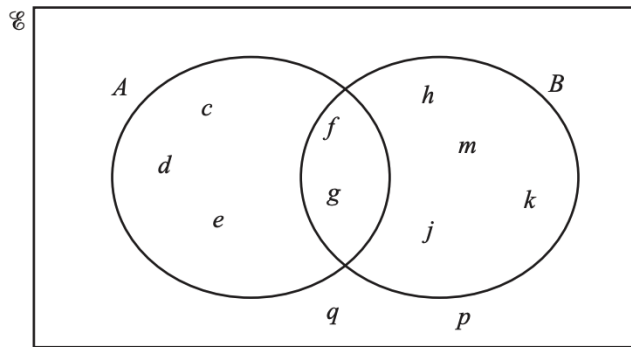
$ .... [1]

(ii) Without doing any calculation, complete this statement.

The actual total value of these 29 parcels is less than the answer to **part (f)(i)**

because .... [1]

9 **(a)** The Venn diagram shows two sets, A and B.

    (i) Use set notation to complete the statements.

        (a) d .... A [1]

        (b) $\{f, g\}$ = ...   [1]

    (ii) Complete the statement.

$$\text{n} (..........................) = 6$$

                                                                      [1]

(b) In the Venn diagram below, shade $C \cap D'$.
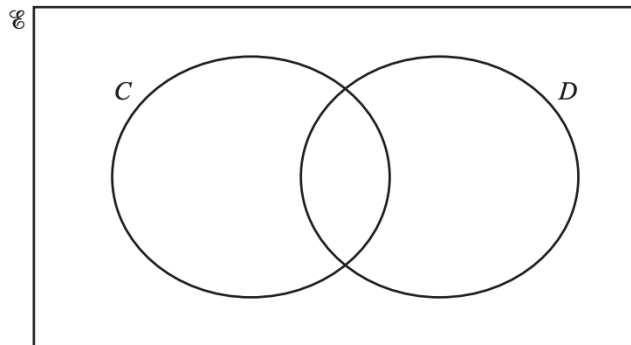
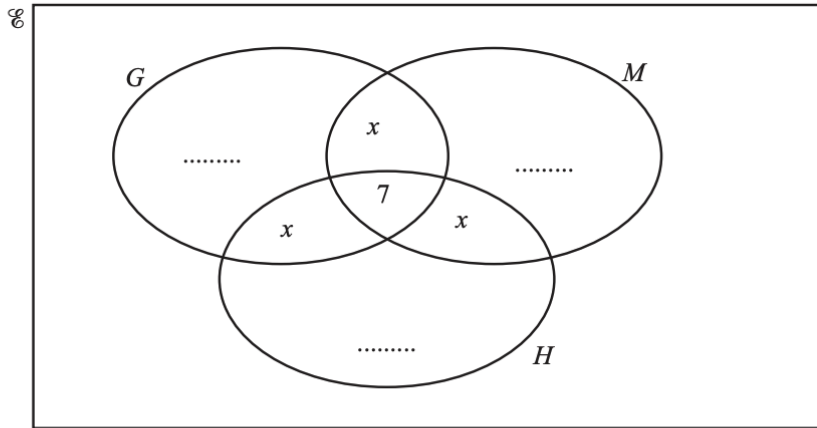   [1]

(c) 50 students study at least one of the subjects geography (G), mathematics (M) and history (H).

18 study only mathematics.
19 study two or three of these subjects.
23 study geography.

The Venn diagram below is to be used to show this information.

(i) Show that $x = 4$.

[2]

(ii) Complete the Venn diagram. [2]

(iii) Use set notation to complete this statement.

$(G \cup M \cup H)' =$ .... [1]

(iv) Find $n(G \cap (M \cup H))$.

.... [1]

11 (a) The table shows the first five terms of sequence A and sequence B.

Term	1	2	3	4	5	6
Sequence A	7	13	23	37	55	
Sequence B	1	3	9	27	81	

    (i) Complete the table for the 6th term of each sequence. [2]

  (ii) Find the nth term of

    (a) sequence A,

                                .... [2]

    (b) sequence B.

                                  .... [2]

(b) The nth term of another sequence is $4n^2 + n + 3$.

  Find

  (i) the 2nd term,

                                  .... [1]

  (ii) the value of n when the nth term is 498.

                         $n = $ .... [3]

28

6 $\mathscr{E} = \{$students in a school$\}$
$F = \{$students who play football$\}$
$B = \{$students who play baseball$\}$

There are 240 students in the school.

- 120 students play football
- 40 students play baseball
- 90 students play football but not baseball.

(a) Complete the Venn diagram to show this information.
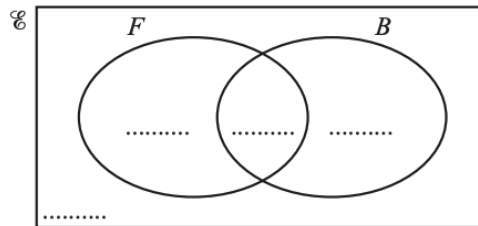
[2]

(b) Find $\text{n}(F' \cap B')$.

.... [1]

(c) A student in the school is chosen at random.

Find the probability that this student plays baseball but not football.

.... [1]

(d) Two students who play baseball are chosen at random.

Find the probability that they both also play football.

.... [3]

8 **(a)** The price of a book increases from $2.50 to $2.65 .

Calculate the percentage increase.

.... % [3]

(b) Scott invests $500 for 7 years at a rate of 1.5% per year simple interest.

Calculate the value of his investment at the end of the 7 years.

$.................................... [3]

(c) In a city the population is increasing exponentially at a rate of 1.6% per year.

Find the overall percentage increase at the end of 20 years.

.... % [2]

(d) The population of a village is 6400.
The population is decreasing exponentially at a rate of r% per year.
After 22 years, the population will be 2607.

Find the value of r.

$r =$ .... [3]

11 Brad travelled from his home in New York to Chamonix.

- He left his home at 16 30 and travelled by taxi to the airport in New York.
  This journey took 55 minutes and had an average speed of 18 km/h.

- He then travelled by plane to Geneva, departing from New York at 22 15.
  The flight path can be taken as an arc of a circle of radius 6400 km with a sector angle of 55.5°.
  The local time in Geneva is 6 hours ahead of the local time in New York.
  Brad arrived in Geneva at 11 25 the next day.

- To complete his journey, Brad travelled by bus from Geneva to Chamonix.
  This journey started at 13 00 and took 1 hour 36 minutes.
  The average speed was 65 km/h.
  The local time in Chamonix is the same as the local time in Geneva.

Find the overall average speed of Brad's journey from his home in New York to Chamonix.
Show all your working and give your answer in km/h.

.... km/h [11]

1   (a)   The price of a newspaper increased from $0.97 to $1.13 .

Calculate the percentage increase.

.... % [3]

(b)   One day, the newspaper had 60 pages of news and advertisements.
The ratio   number of pages of news : number of pages of advertisements =   5 : 7.

(i)   Calculate the number of pages of advertisements.

.... [2]

(ii)   Write the number of pages of advertisements as a percentage of the number of pages of news.

.... % [1]

(c)   On holiday Maria paid 2.25 euros for the newspaper when the exchange rate was $1 = 0.9416 euros.
At home Maria paid $1.13 for the newspaper.

Calculate the difference in price.
Give your answer in dollars, correct to the nearest cent.

$ .... [3]

(d) The number of newspapers sold decreases exponentially by $x\%$ each year.
Over a period of 21 years the number of newspapers sold decreases from 1 763 000 to 58 000.
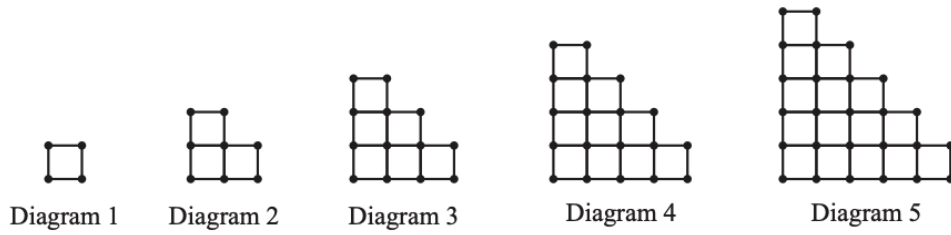
Calculate the value of x.

$x =$ .... [3]

(e) Every page of the newspaper is a rectangle measuring 43 cm by 28 cm, both correct to the nearest centimetre.

Calculate the upper bound of the area of a page.

.... cm^2 [2]

11

Diagram 1   Diagram 2   Diagram 3   Diagram 4   Diagram 5

The sequence of diagrams above is made up of small lines and dots.

(a) Complete the table.

	Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5	Diagram 6
Number of small lines	4	10	18	28		
Number of dots	4	8	13	19		

[4]

(b) For Diagram n find an expression, in terms of n, for the number of small lines.

.... [2]

(c) Diagram r has 10 300 small lines.

Find the value of r.

$r =$ .... [2]

(d) The number of dots in Diagram n is $an^2 + bn + 1$.

Find the value of a and the value of b.

$a = $ ....

$b = $ .... [2]

1   Here is part of a train timetable for a journey from London to Marseille.
    All times given are in local time.
    The local time in Marseille is 1 hour ahead of the local time in London.

London	07 19
Ashford	07 55
Lyon	13 00
Avignon	14 08
Marseille	14 46

(a) (i) Work out the total journey time from London to Marseille.
          Give your answer in hours and minutes.

                                        .... h .... min [2]

     (ii) The distance from London to Ashford is 90 km.
           The local time in London is the same as the local time in Ashford.

           Work out the average speed, in km/h, of the train between London and Ashford.

                                        .... km/h [3]

     (iii) During the journey, the train takes 35 seconds to completely cross a bridge.
            The average speed of the train during this crossing is 90 km/h.
            The length of the train is 95 metres.

            Calculate the length, in metres, of this bridge.

                                        .... m [4]

(b) The fares for the train journey are shown in the table below.

From London to Marseille	Standard fare	Premier fare
Adult	$84	$140
Child	$60	$96

(i) For the **standard fare**, write the ratio   adult fare : child fare   in its simplest form.

.... : .... [1]

(ii) For an **adult**, find the percentage increase in the cost of the standard fare to the premier fare.

.... % [3]

(iii) For one journey from London to Marseille, the ratio

number of adults : number of children = 11 : 2.

There were 220 adults in total on this journey.
All of the children and 70% of the adults paid the standard fare.
The remaining adults paid the premier fare.

Calculate the total of the fares paid by the adults and the children.

$ .... [5]

(c) There were 3.08×10^5 passengers that made this journey in 2018.
This was a 12% decrease in the number of passengers that made this journey in 2017.

Find the number of passengers that made this journey in 2017.
Give your answer in standard form.

.... [3]

37

10 (a) 19, 15, 11, 7, ...

    (i) Write down the next two terms of the sequence.

.... , ... [2]

    (ii) Find the nth term of this sequence.

.... [2]

    (iii) Find the value of n when the nth term is -65.

$n = $ .... [2]

(b) Another sequence has nth term $2n^2 + 5n - 15$.

Find the difference between the 4th term and the 5th term of this sequence.

.... [2]

38

2 **(a)** Ali and Mo share a sum of money in the ratio Ali : Mo = 9 : 7.
Ali receives $600 more than Mo.

Calculate how much each receives.

Ali $ ....

Mo $ .... [3]

(b) In a sale, Ali buys a television for $195.80 .
The original price was $220.

Calculate the percentage reduction on the original price.

.... % [3]

(c) In the sale, Mo buys a jacket for $63.
The original price was reduced by 25%.

Calculate the original price of the jacket.

$ .... [3]

3 **(a)** Dina invests $600 for 5 years at a rate of 2% per year compound interest.

Calculate the value of this investment at the end of the 5 years.

$ .... [2]

(b) The value of a gold ring increases exponentially at a rate of 5% per year.
The value is now $882.

(i) Calculate the value of the ring 2 years ago.

$ .... [2]

(ii) Find the number of complete years it takes for the ring's value of $882 to increase to a value greater than $1100.

.... [2]

10 **(a)** Complete the table for the 5th term and the nth term of each sequence.

1st term	2nd term	3rd term	4th term	5th term		nth term
9	5	1	−3			
4	9	16	25			
1	8	27	64			
8	16	32	64			

[11]

(b)   0,   1,   1,   2,   3,   5,   8,   13,   21,   …

This sequence is a Fibonacci sequence.
After the first two terms, the rule to find the next term is "add the two previous terms".
For example, $5 + 8 = 13$.

Use this rule to complete each of the following Fibonacci sequences.

    2   4   ....

    1   11

    ....   −1   1

[3]

(c) $\frac{1}{3}$, $\frac{3}{4}$, $\frac{4}{7}$, $\frac{7}{11}$, $\frac{11}{18}$,   …

(i) One term of this sequence is $\frac{p}{q}$.

Find, in terms of p and q, the next term in this sequence.

.... [1]

(ii) Find the 6th term of this sequence.

.... [1]

1   **(a)** Mohsin has 600 pear trees and 720 apple trees on his farm.

   (i) Write the ratio   pear trees : apple trees   in its simplest form.

.... : .... [1]

   (ii) Each apple tree produces 16 boxes of apples each year.
   One box contains 18 kg of apples.

   Calculate the total mass of apples produced by the 720 trees in one year.
   Give your answer in standard form.

.... kg [3]

(b) **(i)** One week, the total mass of pears picked was 18 540 kg.
   For this week, the ratio   mass of apples : mass of pears = 13 : 9.

   Find the mass of apples picked that week.

.... kg [2]

   (ii) The apples cost Mohsin $0.85 per kilogram to produce.
   He sells them at a profit of 60%.

   Work out the selling price per kilogram of the apples.

$ .... [2]

(c) Mohsin exports some of his pears to a shop in Belgium.
The shop buys the pears at $1.50 per kilogram.
The shop sells the pears for 2.30 euros per kilogram.
The exchange rate is $1 = 0.92 euros.

Calculate the percentage profit per kilogram made by the shop.

.... % [5]

(d) Mohsin's earnings increase exponentially at a rate of 8.7% each year.
During 2018 he earned $195 600.

During 2027, how much **more** does he earn than during 2018?

$ .... [3]

9   Car *A* and car *B* take part in a race around a circular track.
    One lap of the track measures 7.6 km.

    Car *A* takes 2 minutes and 40 seconds to complete each lap of the track.
    Car *B* takes 2 minutes and 25 seconds to complete each lap of the track.
    Both cars travel at a constant speed.

    (a) Calculate the speed of car *A*.
        Give your answer in kilometres per hour.

        .... km/h [3]

    (b) Both cars start the race from the same position, *S*, at the same time.

        (i) Find the time taken when both car *A* and car *B* are next at position *S* **at the same time**.
            Give your answer in minutes and seconds.

            .... min .... s [4]

        (ii) Find the distance that car *A* has travelled at this time.

            .... km [2]

1   (a)   In a cycling club, the number of members are in the ratio males : females = 8 : 3.
The club has 342 females.

   (i)   Find the total number of members.

.... [2]

   (ii)   Find the percentage of the total number of members that are female.

.... % [1]

(b)   The price of a bicycle is $1020.
Club members receive a 15% discount on this price.

Find how much a club member pays for this bicycle.

$ .... [2]

(c)   In 2019, the membership fee of the cycling club is $79.50 .
This is 6% more than last year.

Find the **increase** in the cost of the membership.

$ .... [3]

(d) Asif cycles a distance of 105 km.
On the first part of his journey he cycles 60 km in 2 hours 24 minutes.
On the second part of his journey he cycles 45 km at 20 km/h.

Find his average speed for the whole journey.

.... km/h [4]

(e) Bryan invested $480 in an account 4 years ago.
The account pays compound interest at a rate of 2.1% per year.
Today, he uses some of the money in this account to buy a bicycle costing $430.

Calculate how much money remains in his account.

$ .... [3]

(f) The formula $s = \frac{1}{2}at^2$ is used to calculate the distance, s, travelled by a bicycle.

When $a = 3$ and $t = 10$, each correct to the nearest integer, calculate the lower bound of the distance, s.

.... [2]

46

1   (a)   A shop sells dress fabric for $2.97 per metre.

(i)   A customer buys 9 metres of this fabric.

Calculate the change he receives from $50.

$ .... [2]

(ii)   The selling price of $2.97 per metre is an increase of 8% on the cost price.

Calculate the cost price.

$ .... per metre [3]

(b)   A dressmaker charges $35 or 2300 rupees to make a dress.

Calculate the difference in price when the exchange rate is   1 rupee = $0.0153 .
Give your answer in rupees.

.... rupees [2]

(c)   The dressmaker measures a length of fabric as 600 m, correct to the nearest 5 metres.
He cuts this into dress lengths of 9 m, correct to the nearest metre.

Calculate the largest number of complete dress lengths he could cut.

.... [3]

11   The table shows the first five terms of sequences *A*, *B* and *C*.

Sequence	1st term	2nd term	3rd term	4th term	5th term	6th term
A	0	1	4	9	16	
B	4	5	6	7	8	
C	−4	−4	−2	2	8	

(a) Complete the table.   [3]

(b) Find an expression for the *n*th term of

(i)   sequence *A*,

.... [2]

(ii)   sequence *B*.

.... [1]

(c) Find the value of *n* when the *n*th term of sequence *A* is 576.

n = ... [2]

(d) (i)   Find an expression for the *n*th term of sequence *C*.
          Give your answer in its simplest form.

.... [3]

(ii)   Find the value of the 30th term of sequence *C*.

.... [2]

1   Adele, Barbara and Collette share $680 in the ratio 9 : 7 : 4.

   (a) Show that Adele receives $306.

                                                                              [1]

   (b) Calculate the amount that Barbara and Collette each receives.

                                         Barbara $ ....

                                         Collette $ .... [3]

   (c) Adele changes her $306 into euros (€) when the exchange rate is €1 = $1.125 .

   Calculate the number of euros she receives.

                                         € .... [2]

   (d) Barbara spends a total of $17.56 on 5 kg of apples and 3 kg of bananas.
          Apples cost $2.69 per kilogram.

   Calculate the cost per kilogram of bananas.

                                         $ .... [3]

   (e) Collette spends half of her share on clothes and $\frac{1}{5}$ of her share on books.

   Calculate the amount she has left.

                                         $ .... [3]

3 **(a)** The price of a house decreased from $82 500 to $77 500.

Calculate the percentage decrease.

.... % [3]

(b) Roland invests $12 000 in an account that pays compound interest at a rate of 2.2% per year.

Calculate the value of his investment at the end of 6 years.
Give your answer correct to the nearest dollar.

$ .... [3]

10 (a) In 2017, the membership fee for a sports club was $79.50 .
This was an increase of 6% on the fee in 2016.

Calculate the fee in 2016.

$ .... [3]

(b) On one day, the number of members using the exercise machines was 40, correct to the nearest 10.
Each member used a machine for 30 minutes, correct to the nearest 5 minutes.

Calculate the lower bound for the number of minutes the exercise machines were used on this day.

.... min [2]

(c) On another day, the number of members using the exercise machines (E), the swimming pool (S) and
the tennis courts (T) is shown on the Venn diagram.
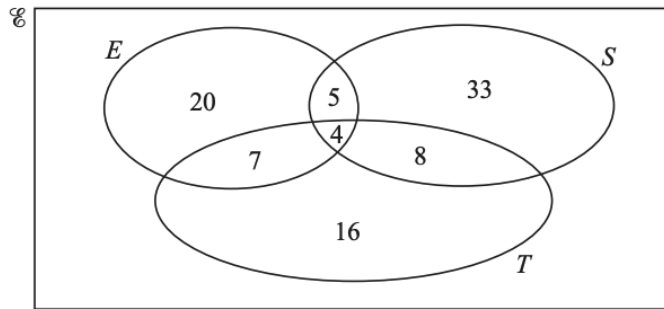
(i) Find the number of members using only the tennis courts.

.... [1]

(ii) Find the number of members using the swimming pool.

.... [1]

(iii) A member using the swimming pool is chosen at random.

Find the probability that this member also uses the tennis courts and the exercise machines.

.... [2]

(iv) Find n$(T\cap(E\cup S))$.

.... [1]

12 Marco is making patterns with grey and white circular mats.

Pattern 1   Pattern 2   Pattern 3   Pattern 4
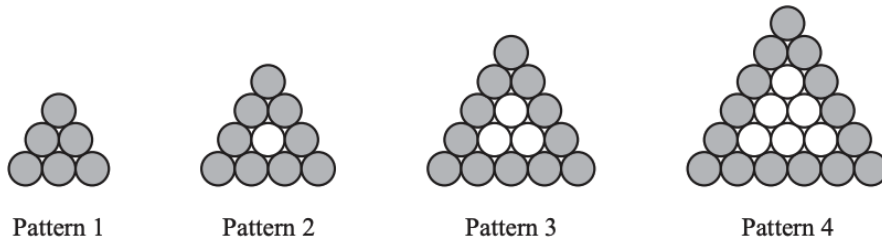
The patterns form a sequence.
Marco makes a table to show some information about the patterns.

Pattern number	1	2	3	4	5
Number of grey mats	6	9	12	15	
Total number of mats	6	10	15	21	

(a) Complete the table for Pattern 5. [2]

(b) Find an expression, in terms of n, for the number of grey mats in Pattern n.

.... [2]

(c) Marco makes a pattern with 24 grey mats.

Find the total number of mats in this pattern.

.... [2]

(d) Marco needs a total of 6 mats to make the first pattern.
He needs a total of 16 mats to make the first two patterns.
He needs a total of $\frac{1}{6}n^3 + an^2 + bn$ mats to make the first n patterns.

Find the value of a and the value of b.

$a =$ ....

$b =$ .... [6]

1　(a)　Here is a list of ingredients to make 20 biscuits.

> 260g of butter
> 500g of sugar
> 650g of flour
> 425g of rice

(i)　Find the mass of rice as a percentage of the mass of sugar.

.... % [1]

(ii)　Find the mass of butter needed to make 35 of these biscuits.

.... g [2]

(iii)　Michel has 2 kg of each ingredient.

Work out the greatest number of these biscuits that he can make.

.... [3]

(b)　A company makes these biscuits at a cost of $1.35 per packet.
These biscuits are sold for $1.89 per packet.

(i)　Calculate the percentage profit the company makes on each packet.

.... % [3]

(ii)　The selling price of $1.89 has increased by 8% from last year.

Calculate the selling price last year.

$ .... [3]

(c) Over a period of 3 years, the company's sales of biscuits increased from 15.6 million packets to 20.8 million packets.
The sales increased exponentially by the same percentage each year.

Calculate the percentage increase **each year**.

.... % [3]

(d) The people who work for the company are in the following age groups.

Group A	Group B	Group C
Under 30 years	30 to 50 years	Over 50 years

The ratio of the number in group A to the number in group B is   7 : 10.
The ratio of the number in group B to the number in group C is   4 : 3.

(i) Find the ratio of the number in group A to the number in group C.
Give your answer in its simplest form.

.... : .... [3]

(ii) There are 45 people in group C.

Find the total number of people who work for the company.

.... [3]

1 (a) Rowena buys and sells clothes.

(i) She buys a jacket for $40 and sells it for $45.40 .

Calculate the percentage profit.

.... % [3]

(ii) She sells a dress for $42.60 after making a profit of 20% on the cost price.

Calculate the cost price.

$ .... [3]

(b) Sara invests $500 for 15 years at a rate of 2% per year simple interest.

Calculate the total interest Sara receives.

$ .... [2]

(c) Tomas has two cars.

    (i) The value, today, of one car is \$21 000.
        The value of this car **decreases** exponentially by 18% each year.

        Calculate the value of this car after 5 years.
        Give your answer correct to the nearest hundred dollars.

        \$ .... [3]

    (ii) The value, today, of the other car is \$15 000.
        The value of this car **increases** exponentially by x% each year.
        After 12 years the value of the car will be \$42 190.

        Calculate the value of x.

        $x =$ .... [3]

1   Marianne sells photos.

(a)   The selling price of each photo is $6.

(i)   The selling price for each photo is made up of two parts, printing cost and profit.
For each photo, the ratio   printing cost : profit = 5 : 3.

Calculate the profit she makes on each photo.

$ .... [2]

(ii)   Calculate her profit as a percentage of the selling price.

....% [1]

(iii)   Calculate the selling price of a photo in euros (€) when the exchange rate is   €1 = $1.091 .

€ .... [2]

(b)   Marianne sells two sizes of photo.
These photos are mathematically similar rectangles.
The smaller photo has length 15 cm and width 12 cm.
The larger photo has area 352.8 cm^2.

Calculate the length of the larger photo.

.... cm [3]

(c)   In a sale, Marianne buys a new camera for $483.
This is a reduction of 8% on the original price.

Calculate the original price of the camera.

$ .... [3]

58

6   (a)
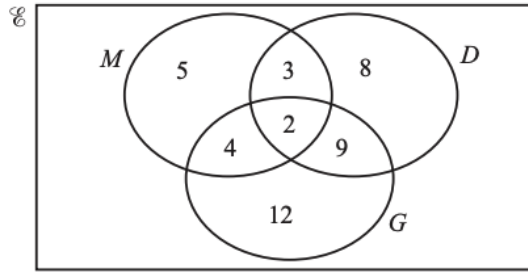
The Venn diagram above shows information about the number of students who study Music (*M*), Drama (*D*) and Geography (*G*).
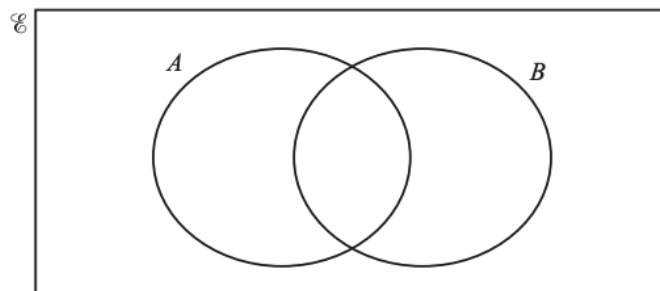
(i)   How many students study Music?

.... [1]

(ii)   How many students study exactly two subjects?

.... [1]

(iii)   Two students are chosen at random from those who study Drama.

Calculate the probability that they both also study Music.

.... [3]

(iv)   In the Venn diagram above, shade $M \cap D'$.   [1]

(b)   (i) $\mathcal{E} = \{x : x \text{ is an integer and } 1 \leqslant x \leqslant 10\}$

$A = \{x : x \text{ is even}\}$

$4 \in A \cap B$

$n(A \cap B) = 1$

$(A \cup B)' = \{1, 7, 9\}$

Complete the Venn diagram below using this information.

[4]

(ii)   Use your Venn diagram to complete the statement.

$B = \{..\}$ [1]

1   (a)   The Muller family are on holiday in New Zealand.

   (i)   They change some euros (€) and receive $1962 (New Zealand dollars).
          The exchange rate is €1 = $1.635 .

          Calculate the number of euros they change.

                                                          € .... [2]

   (ii)   The family spend 15% of their New Zealand dollars on a tour.

          Calculate the number of dollars they have left.

                                                          $ .... [2]

   (iii) The family visit two waterfalls, the Humboldt Falls and the Bridal Veil Falls.
          The ratio of the heights   Humboldt Falls : Bridal Veil Falls = 5 : 1.
          The Humboldt Falls are 220 m higher than the Bridal Veil Falls.

          Calculate the height of the Humboldt Falls.

                                                          .... m [2]

(b) (i) Water flows over the Browne Falls at a rate of 3680 litres per second.
After rain, this rate increases to 9752 litres per second.

Calculate the percentage increase in this rate.

.... % [3]

(ii) After rain, water flows over the Sutherland Falls at a rate of 74 240 litres per second.
This is an increase of 45% on the rate before the rain.

Calculate the rate before the rain.

.... litres/second [3]

2 **(a)** A school has 240 students.
The ratio girls : boys = 25 : 23.

    (i) Show that the number of boys is 115.

                                               [1]

    (ii) One day, there are 15 girls absent and 15 boys absent.

        Find the ratio girls : boys in school on this day.
        Give your answer in its simplest form.

                                  .... : .... [2]

    (iii) Next year, the number of students will increase by 15%.

        Calculate the number of students next year.

                                   .... [2]

    (iv) Since the school was opened, the number of students has increased by 60%.
        There are now 240 students.

        Calculate the number of students when the school was opened.

                                   .... [3]

(b) The population of a city is increasing exponentially at a rate of 2% each year.
The population now is 256 000.

Calculate the population after 30 years.
Give your answer correct to the nearest thousand.

.... [3]

(c) A bacteria population increases exponentially at a rate of r% each day.
After 32 days, the population has increased by 309%.

Find the value of r.

$r =$ .... [3]

10 (a) Find the next term and the nth term of this sequence.

$$\frac{3}{5}, \quad \frac{4}{7}, \quad \frac{5}{9}, \quad \frac{6}{11}, \quad \frac{7}{13}, \quad \cdots$$

Next term = ...

nth term = ... [3]

(b) Find the nth term of each sequence.

(i) $-1, \quad -3, \quad -5, \quad -7, \quad -9, \quad \ldots$

.... [2]

(ii) $2, \quad 9, \quad 28, \quad 65, \quad 126, \quad \ldots$

.... [2]

1   The Smith family paid $5635 for a holiday in India.
    The total cost was divided in the ratio   travel : accommodation : entertainment = 10 : 17 : 8.

    (a)   Calculate the percentage of the total cost spent on entertainment.

    ....% [2]

    (b)   Show that the amount spent on accommodation was $2737.

    [2]

    (c)   The $5635 was the total amount Mr Smith received from an investment he made 5 years ago.
    Compound interest at a rate of 2.42% per year was paid on this investment.

    Calculate the amount he invested 5 years ago.

    $ .... [3]

    (d)   Mr Smith, his wife and their three children visit a theme park.
    The tickets cost 2500 Rupees for an adult and 1650 Rupees for a child.

    Calculate the total cost of the tickets.

    .... Rupees [2]

    (e)   One day the youngest child spent 130 Rupees on sweets.
    On this day the exchange rate was 1 Rupee = $0.0152 .

    Calculate the value of the sweets in dollars, correct to the nearest cent.

    $ .... [2]

1 An energy company charged these prices in 2013.

Electricity price	Gas price
23.15 cents per day plus 13.5 cents for each unit used	24.5 cents per day plus 5.5 cents for each unit used

(a) (i) In 90 days, the Siddique family used 1885 units of **electricity**.

Calculate the total cost, in dollars, of the electricity they used.

$ .... [2]

(ii) In 90 days, the **gas** used by the Khan family cost $198.16 .

Calculate the number of units of gas used.

.... units [3]

(b) In 2013, the price for each unit of electricity was 13.5 cents.
Over the next 3 years, this price increased exponentially at a rate of 8% per year.

Calculate the price for each unit of electricity after 3 years.

.... cents [2]

(c) Over these 3 years, the price for each unit of gas increased from 5.5 cents to 7.7 cents.

(i) Calculate the percentage increase from 5.5 cents to 7.7 cents.

.... % [3]

(ii) Over the 3 years, the 5.5 cents increased exponentially by the same percentage each year to 7.7 cents.

Calculate the percentage increase **each year**.

.... % [3]

(d) In 2015, the energy company divided its profits in the ratio

shareholders : bonuses : development $= 5 : 2 : 6$.

In 2015, its profits were $390 million.

Calculate the amount the company gave to shareholders.

$ .... million [2]

(e) The share price of the company in June 2015 was $258.25 .
This was an increase of 3.3% on the share price in May 2015.

Calculate the share price in May 2015.

$ .... [3]

9 **(a)** The nth term of a sequence is $8n - 3$.

    (i) Write down the first two terms of this sequence.

                                               .... , ... [1]

    (ii) Show that the number 203 is not in this sequence.

                                                                      [2]

(b) Find the nth term of these sequences.

    (i) 13,   19,   25,   31,   …

                                       .... [2]

    (ii) 4,   8,   14,   22,   …

                                       .... [2]

(c)   … ,   20,   50,   …

The second term of this sequence is 20 and the third term is 50.
The rule for finding the next term in this sequence is subtract y then multiply by 5.

Find the value of y and work out the first term of this sequence.

                                       $y = $ ....

                           First term = ... [4]

1   (a)   Annie and Dermot share $600 in the ratio 11 : 9.

    (i)   Show that Annie receives $330.

         [1]

    (ii)   Find the amount that Dermot receives.

$ .... [1]

  (b)   (i)   Annie invests $330 at a rate of 1.5% per year compound interest.

        Calculate the amount that Annie has after 8 years.
Give your answer correct to the nearest dollar.

$ .... [3]

    (ii)   Find the amount of **interest** that Annie has, after the 8 years, as a percentage of the $330.

.... % [2]

(c) Dermot has $70 to spend.
He spends $24.75 on a shirt.

    (i) Find $24.75 as a fraction of $70.
        Give your answer in its lowest terms.

        .... [1]

    (ii) The $24.75 is the sale price after reducing the original price by 10%.

        Calculate the original price.

        $ .... [3]

(d) After one year, the value of Annie's car had reduced by 20%.
At the end of the second year, the value of Annie's car had reduced by a further 15% of its value at the end of the first year.

    (i) Calculate the overall percentage reduction after the two years.

        .... % [2]

    (ii) After three years the overall percentage reduction in the value of Annie's car is 40.84%.

        Calculate the percentage reduction in the third year.

        .... % [2]

1   (a)   In 2016, a company sold 9600 cars, correct to the nearest hundred.

   (i)   Write down the lower bound for the number of cars sold.

   .... [1]

   (ii)   The average profit on each car sold was $2430, correct to the nearest $10.

   Calculate the lower bound for the total profit.
   Write down the exact answer.

   $... [2]

   (iii)   Write your answer to **part (a)(ii)** correct to 4 significant figures.

   $... [1]

   (iv)   Write your answer to **part (a)(iii)** in standard form.

   $... [1]

   (b)   In April, the number of cars sold was 546.
        This was an increase of 5% on the number of cars sold in March.

   Calculate the number of cars sold in March.

   .... [3]

   (c)   The price of a new car grows exponentially by 3% per year.
        A new car has a price of $3000 in 2013.

   Find the price of a new car 4 years later.

   $... [2]

10 $\mathcal{E} = \{21, 22, 23, 24, 25, 26, 27, 28, 29, 30\}$
$A = \{\, x : x \text{ is a multiple of 3}\}$
$B = \{\, x : x \text{ is prime}\}$
$C = \{\, x : x \leqslant 25\}$

(a) Complete the Venn diagram.
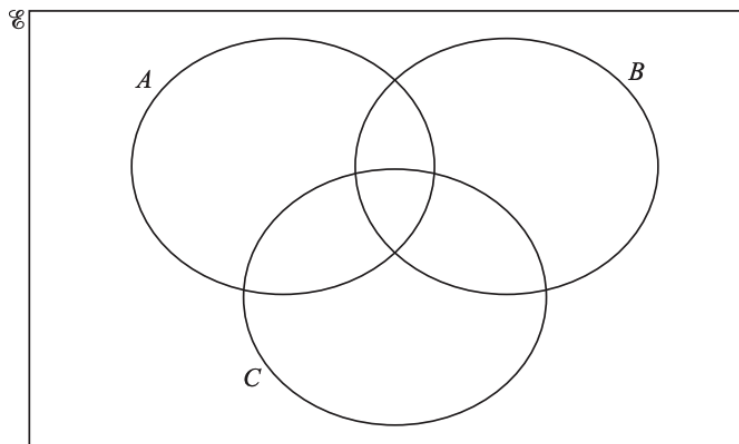
[4]

(b) Use set notation to complete the statements.

    (i)   26 .... B [1]

    (ii) $A \cap B = $ ....   [1]

(c) List the elements of $B \cup (C \cap A)$.

.... [2]

(d) Find

    (i)   n(C),

.... [1]

    (ii)   n$\big(B' \cup (B \cap C)\big)$.

.... [1]

(e) $(A \cap C)$ is a subset of $(A \cup C)$.

Complete this statement using set notation.

$(A \cap C)$ .... $(A \cup C)$ [1]

11   The table shows the first four terms in sequences A, B, C and D.

Complete the table.

Sequence	1st term	2nd term	3rd term	4th term	5th term		nth term
A	16	25	36	49			
B	5	8	11	14			
C	11	17	25	35			
D	$\dfrac{3}{2}$	$\dfrac{4}{3}$	$\dfrac{5}{4}$	$\dfrac{6}{5}$			

[12]

73

1 **(a)** A library has a total of 10 494 fiction and non-fiction books.
The ratio   fiction books : non-fiction books = 13 : 5.

Find the number of non-fiction books the library has.

.... [2]

(b) The library has DVDs on crime, adventure and science fiction.
The ratio   crime : adventure : science fiction = 11 : 6 : 10.
The library has 384 **more** science fiction DVDs than adventure DVDs.

Calculate the number of crime DVDs the library has.

.... [2]

(c) Every Monday, Sima travels by car to the library.
The distance is 20 km and the journey takes 23 minutes.

(i) Calculate the average speed for the journey in kilometres per hour.

.... km/h [2]

(ii) One Monday, she is delayed and her average speed is reduced to 32 km/h.

Calculate the percentage increase in the journey time.

.... % [5]

(d) In Spain, the price of a book is 11.99 euros.
In the USA, the price of the same book is $12.99 .
The exchange rate is $1 = 0.9276 euros.

Calculate the difference between these prices.
Give your answer in dollars, correct to the nearest cent.

$... [3]

(e) 7605 books were borrowed from the library in 2016.
This was 22% less than in 2015.

Calculate the number of books borrowed in 2015.

.... [3]

6

Diagram 1   Diagram 2   Diagram 3   Diagram 4
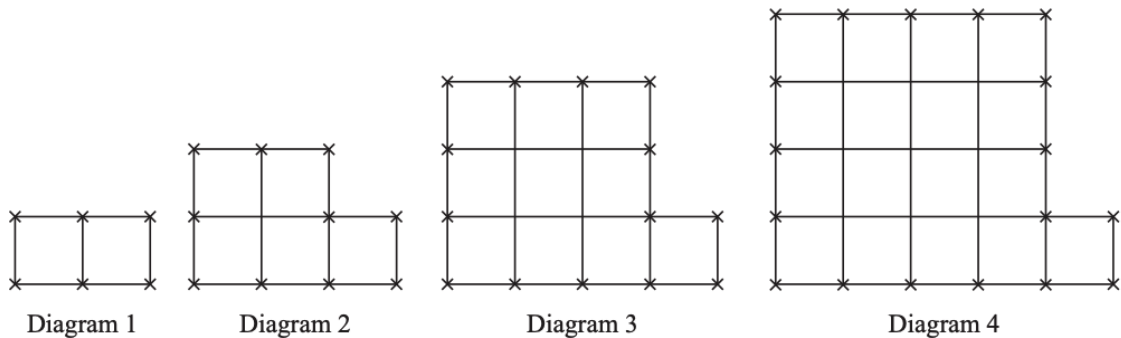
These are the first four diagrams in a sequence.
Each diagram is made from small squares and crosses.

(a) Complete the table.

Diagram	1	2	3	4	5		n
Number of crosses	6	10	14				
Number of small squares	2	5	10				

[6]

(b) Find the number of crosses in Diagram 60.

.... [1]

(c) Which diagram has 226 squares?

Diagram .... [1]

(d) The side of each small square has length 1 cm.
The number of lines of length 1 cm in Diagram n is $2n^2 + 2n + q$.

Find the value of q.

$q =$ .... [2]

1　(a)　Alex has $20 and Bobbie has $25.

　　(i)　Write down the ratio　Alex's money : Bobbie's money　in its simplest form.

　　　　　........................ : .... [1]

　　(ii)　Alex and Bobbie each spend $\frac{1}{5}$ of their money.

　　　　Find the ratio　Alex's remaining money : Bobbie's remaining money　in its simplest form.

　　　　　........................ : .... [1]

　　(iii)　Alex and Bobbie **then** each spend $4.

　　　　Find the new ratio　Alex's remaining money : Bobbie's remaining money　in its simplest form.

　　　　　........................ : .... [2]

　(b)　(i)　The population of a town in the year 1990 was 15 600.
　　　　The population is now 11 420.

　　　　Calculate the percentage decrease in the population.

　　　　　...% [3]

　　(ii)　The population of 15 600 was 2.5% less than the population in the year 1980.

　　　　Calculate the population in the year 1980.

　　　　　... [3]

(c) Chris invests $200 at a rate of x% per year simple interest.
At the end of 15 years the total interest received is $48.

Find the value of x.

$x =$ .... [2]

(d) Dani invests $200 at a rate of y% per year compound interest.
At the end of 10 years the value of her investment is $256.

Calculate the value of y, correct to 1 decimal place.

$y =$ .... [3]

3   The graph shows information about the journey of a train between two stations.
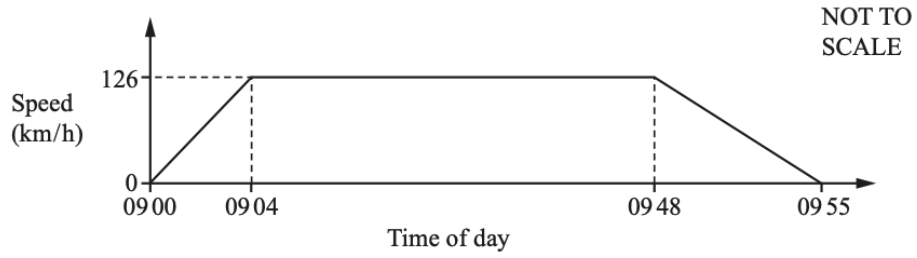
(a) (i)   Work out the acceleration of the train during the first 4 minutes of this journey.
          Give your answer in km/h².

          .... km/h² [2]

     (ii) Calculate the distance, in kilometres, between the two stations.

          ....km [4]

(b) (i) Show that 126 km/h is the same speed as 35 m/s.

[1]

(ii) The train has a total length of 220 m.
At 09 30, the train crossed a bridge of length 1400 m.

Calculate the time, in seconds, that the train took to completely cross the bridge.

....s [3]

(c) On a different journey, the train took 73 minutes, correct to the nearest minute, to travel 215 km, correct to the nearest 5 km.

Calculate the upper bound of the average speed of the train for this journey.
Give your answer in km/h.

....km/h [4]

10 (a) (i) Write 180 as a product of its prime factors.

.... [2]

(ii) Find the lowest common multiple (LCM) of 180 and 54.

.... [2]

(b) An integer, X, written as a product of its prime factors is $a^2 \times 7^{b+2}$.
An integer, Y, written as a product of its prime factors is $a^3 \times 7^2$.

The highest common factor (HCF) of X and Y is 1225.
The lowest common multiple (LCM) of X and Y is 42 875.

Find the value of X and the value of Y.

$X =$ ....

$Y =$ .... [4]

1   Aasha, Biren and Cemal share $640 in the ratio 8 : 15 : 9.

(a) Show that Aasha receives $160.

[1]

(b) Calculate the amount that Biren and Cemal receive.

Biren $ ....

Cemal $ .... [2]

(c) Aasha uses her $160 to buy some books.
     Each book costs $15.25 .

     Find the greatest number of books that she can buy.

.... [2]

(d) Biren spends $\frac{3}{8}$ of his share on clothes and $\frac{1}{3}$ of his share on a computer.

     Find the fraction of his share that he has left.
     Write your fraction in its lowest terms.

.... [3]

3   (a) Davinder asked some people if they ate mangoes, pineapples or bananas last week.

M = { people who ate mangoes }
P = { people who ate pineapples }
B = { people who ate bananas }

The Venn diagram shows some of the information.
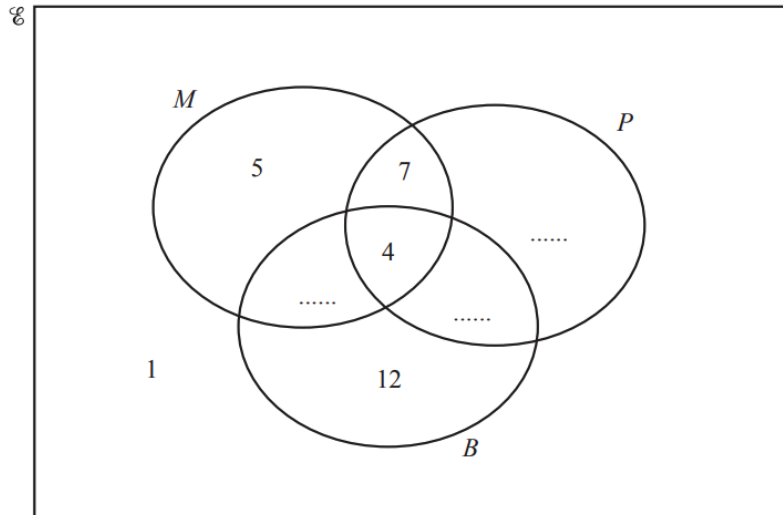
19 people said they ate mangoes.
6 people said they ate **only** pineapples.
18 people said they ate **exactly two** of the three types of fruit.

(i)   Write the three missing values in the Venn diagram. [3]

(ii) Find the total number of people Davinder asked.

.... [1]

(iii) Find n($M \cap P$).

.... [1]

(iv) One person is chosen at random from the people who ate mangoes.

Write down the probability that this person also ate bananas.

.... [2]

(b) Davinder draws a speed-time graph for his bus journey to the market.
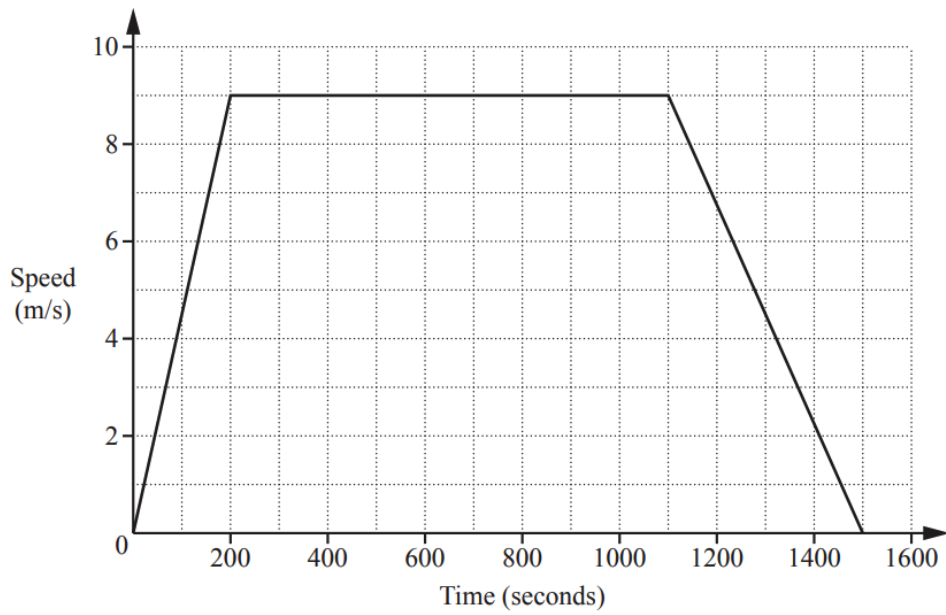
Find

(i) the acceleration of the bus during the first 200 seconds,

.... m/s² [1]

(ii) the total distance travelled by the bus,

.... m [3]

(iii) the average speed of the bus for the whole journey.

.... m/s [1]

5 **(a)** Meena sells her car for $6000.
This is a loss of 4% on the price she paid.

Calculate the price Meena paid for the car.

$ .... [3]

(b) Eisha changes some euros (€) into dollars ($) when the exchange rate is €1 = $1.351 .
She receives $6000.

Calculate how many euros Eisha changes.
Give your answer correct to the nearest euro.

€ .... [3]

(c) Meena and Eisha both invest their $6000.
Meena invests her $6000 at a rate of 1.5% per year compound interest.
Eisha invests her $6000 in a bank that pays simple interest.
After 8 years, their investments are worth the same amount.

Calculate the rate of simple interest per year that Eisha received.

.... % [5]

1 (a) Kristian and Stephanie share some money in the ratio 3 : 2.
          Kristian receives $72.

     (i)   Work out how much Stephanie receives.

                                                      $ .... [2]

     (ii) Kristian spends 45% of his $72 on a computer game.

           Calculate the price of the computer game.

                                                      $ .... [1]

     (iii) Kristian also buys a meal for $8.40 .

           Calculate the fraction of the $72 Kristian has left after buying the computer game and the meal.
           Give your answer in its lowest terms.

                                                      .... [2]

     (iv) Stephanie buys a book in a sale for $19.20 .
           This sale price is after a reduction of 20%.

           Calculate the original price of the book.

                                                      $ .... [3]

(b) Boris invests $550 at a rate of 2% per year simple interest.

Calculate the amount Boris has after 10 years.

$ .... [3]

(c) Marlene invests $550 at a rate of 1.9% per year compound interest.

Calculate the amount Marlene has after 10 years.

$ .... [2]

(d) Hans invests $550 at a rate of x% per year compound interest.
At the end of 10 years he has a total amount of $638.30, correct to the nearest cent.

Find the value of x.

$x =$ .... [3]

1   Mr Chan flies from London to Los Angeles, a distance of 8800 km.
     The flight takes 11 hours and 10 minutes.

     (a) **(i)** His plane leaves London at 09 35 local time.
                      The local time in Los Angeles is 8 hours behind the time in London.

                      Calculate the local time when the plane arrives in Los Angeles.

                      .... [2]

          (ii)   Work out the average speed of the plane in km/h.

                      ....km/h [2]

     (b) There are three types of tickets, economy, business and first class.
              The price of these tickets is in the ratio   economy : business : first class = 2 : 5 : 9.

          (i)   The price of a business ticket is $2350.

                      Calculate the price of a first class ticket.

                      $... [2]

          (ii)   Work out the price of an economy ticket as a percentage of the price of a first class ticket.

                      ....% [1]

     (c) The price of a business ticket for the same journey with another airline is $2240.

          (i)   The price of a first class ticket is 70% more than a business ticket.

                      Calculate the price of this first class ticket.

                      $... [2]

(ii) The price of a business ticket is 180% **more** than an economy ticket.

Calculate the price of this economy ticket.

$.. [3]

(d) Mr Chan hires a car in Los Angeles.
The charges are shown below.

> ### Car Hire
>
> $28.00 per day plus $6.50 per day insurance.
>
> $1.25 for every kilometre travelled after the first 800 km.
> The first 800 km are included in the price.

Mr Chan hired the car for 12 days and paid $826.50 .

(i) Find the number of kilometres Mr Chan travelled in this car.

.... km [4]

(ii) The car used fuel at an average rate of 1 litre for every 10 km travelled.
Fuel costs $1.30 per litre.

Calculate the cost of the fuel used by the car during the 12 days.

$.. [2]

1   A football club sells tickets at different prices dependent on age group.

(a) (i)   At one game, the club sold tickets in the ratio

under 18 : 18 to 60 : over 60 = 2 : 7 : 3.

There were 6100 tickets sold for people aged under 18.

Calculate the **total** number of tickets sold for the game.

.... [3]

(ii)   Calculate the percentage of tickets sold for people aged under 18.

....% [1]

(b)   The table shows the football ticket prices for the different age groups.

Age	Price
Under 18	$15
18 to 60	$35
Over 60	$18

At a **different** game there were 42 600 tickets sold.

- 14% were sold to people aged under 18
- $\frac{2}{3}$ of the tickets were sold to people aged 18 to 60
- The remainder were sold to people aged over 60

Calculate the total amount the football club receives from ticket sales for this game.

$ .... [5]

(c) In a sale, the football club shop reduced the price of the football shirts to $23.80 .
An error was made when working out this sale price.
The price was reduced by 30% instead of 20%.

Calculate the correct sale price for the football shirt.

$.. [5]

10

Diagram 1   Diagram 2   Diagram 3
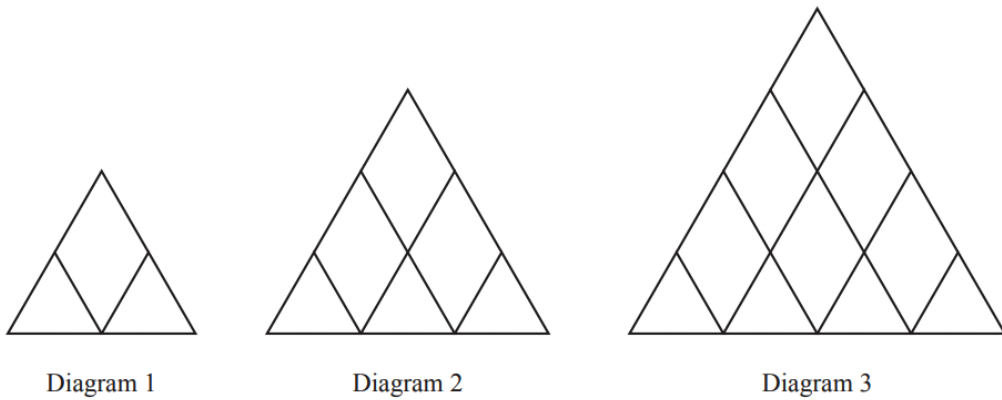
Each diagram is made from tiles in the shape of equilateral triangles and rhombuses.
The length of a side of each tile is 1 unit.

(a) Complete the table below for this sequence of diagrams.

Diagram	1	2	3	4	5
Number of equilateral triangle shaped tiles	2	3	4	5	6
Number of rhombus shaped tiles	1	3	6		
Total number of tiles	3	6	10		
Number of 1 unit lengths	8	15	24		

[6]

(b) (i) The number of 1 unit lengths in Diagram n is $n^2 + 4n + p$.

Find the value of p.

$p =$ .... [2]

(ii) Calculate the number of 1 unit lengths in Diagram 10.

.... [1]

(c) The total number of tiles in Diagram n is $an^2 + bn + 1$.

Find the value of a and the value of b.

$a =$ ....

$b =$ .... [5]

(d) Part of the Louvre museum in Paris is in the shape of a square-based pyramid made from glass tiles. Each of the triangular faces of the pyramid is represented by Diagram 17 in the sequence.

(i) Calculate the total number of glass tiles on one triangular face of this pyramid.

.... [2]

(ii) 11 tiles are removed from one of the triangular faces to create an entrance into the pyramid.

Calculate the total number of glass tiles used to construct this pyramid.

.... [1]

1 (a) (i) Divide $105 in the ratio 4 : 3.

$ .... and $ .... [2]

   (ii) Increase $105 by 12%.

$ .... [2]

   (iii) In a sale the original price of a jacket is reduced by 16% to $105.

       Calculate the original price of the jacket.

$ .... [3]

   (b) Jakob invests $500 at a rate of 2% per year compound interest.
        Claudia invests $500 at a rate of 2.5% per year simple interest.

        Calculate the difference between these two investments after 30 years.
        Give your answer in dollars correct to the nearest cent.

$ .... [6]

(c) Michel invests P at a rate of 3.8% per year compound interest.
After 30 years the value of this investment is $1469.

Calculate the value of P.

$P =$ .... [3]

(d) The population of a city increases exponentially at a rate of x% **every 5 years**.
In 1960 the population was 60 100.
In 2015 the population was 120 150.

Calculate the value of x.

$x =$ .... [3]

1   (a)   (i)   Each year the value of a car decreases by 15% of its value at the beginning of that year.
                Alberto buys a car for $18 000.

                Calculate the value of Alberto's car after 3 years.

                                                            $ .... [2]

      (ii)   Belinda bought a car one year ago.
             The value of this car has decreased by 15% to $14025.

             Calculate how much Belinda paid for the car.

                                                            $ .... [3]

   (b)   Chris invested some money at a rate of 5% per year compound interest.
         After 2 years the value of this investment is $286.65 .

         Calculate how much Chris invested.

                                                            $ .... [2]

(c) Dani invested $200 and after 2 years the value of this investment is $224.72 .

Calculate the rate of interest per year when the interest is

(i) simple,

....% [3]

(ii) compound.

....% [3]

1 (a) A jigsaw puzzle has edge pieces and inside pieces.
The ratio   edge pieces : inside pieces = 3 : 22.

(i) There are 924 inside pieces.

Calculate the total number of pieces in the puzzle.

.... [2]

(ii) Find the percentage of the total number of pieces that are edge pieces.

....% [1]

(iii) Anjum and Betty spent a total of 9 hours completing the puzzle.
The ratio   Anjum's time : Betty's time = 7 : 5.

Work out how much time Anjum spent on the puzzle.

.... hours [2]

(b) The price of the puzzle was $15.99 in a sale.
This was 35% less than the original price.

Calculate the original price of the puzzle.

$.. [3]

(c) Betty takes a photograph of the completed puzzle.
The photograph and the completed puzzle are mathematically similar.

The area of the photograph is $875\,cm^2$ and the area of the puzzle is $2835\,cm^2$.
The length of the photograph is $35\,cm$.

Work out the length of the puzzle.

.... cm [3]

(d) (i) The area of another puzzle is $6610\,cm^2$.

Change $6610\,cm^2$ into m^2.

....m^2 [1]

(ii) The cost price of this puzzle is $12.50 .
The selling price is $18.50 .

Calculate the percentage profit.

....% [3]

10 (a) Complete the table for the four sequences A, B, C and D.

	Sequence				Next term	nth term
A	2	5	8	11		
B	20	14	8	2		
C	1	4	9	16		
D	0	2	6	12		

[10]

(b) The sum of the first n terms of a sequence is $\dfrac{n(3n+1)}{2}$.

    (i) When the sum of the first n terms is 155, show that $3n^2 + n - 310 = 0$.

[2]

    (ii) Solve $3n^2 + n - 310 = 0$.

$n =$ .... or $n =$ .... [3]

    (iii) Complete the statement.

The sum of the first .... terms of this sequence is 155. [1]
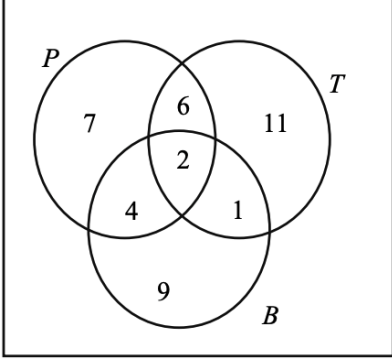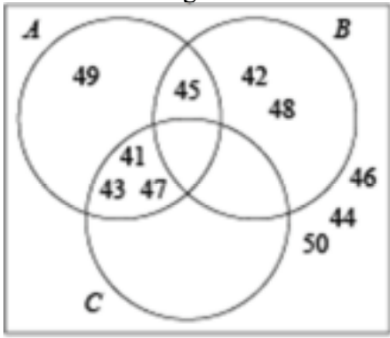
Mathematics
Paper 4

Numbers

ANSWERS
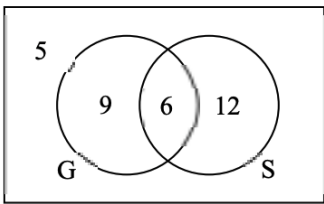
1(a)(i)	295	2	**M1** for $[87 +] 4 \times 52$ oe
1(a)(ii)	29.5 or 29.49…	1	**FT** $\dfrac{87}{their(a)(i)} \times 100$
1(b)	11	2	**M1** for $18 \times 4 \, [\pm 61]$ oe
1(c)	4160 cao nfww	2	**M1** for $64 \div 0.0154$ or **B1** for rounding *their* answer to nearest 10
1(d)	2.4[0] nfww	2	**M1** for $\left(1+\dfrac{12.5}{100}\right)x = 2.7[0]$ oe
1(e)	53 : 36	3	**M2** for $265 : 180$ oe or for answer $36 : 53$ or 53 min: 36 min or **M1** for 4h 25 [mins] or 265 [mins] seen
1(f)	6[.00] or 5.999…	3	**M2** for $\sqrt[5]{\dfrac{736}{550}}$ or **M1** for $736 = 550 \times (x)^5$
3(a)	187	2	**M1** for $220 \times \left(1-\dfrac{15}{100}\right)$ oe or **B1** for 33 seen
7(b)	4.8	3	**M1** for $y = \dfrac{k}{x^2}$ or better **M1** for $[y =]\dfrac{their\,k}{5^2}$ **OR** **M2** for $y \times 5^2 = 7.5 \times 4^2$
7(c)(i)	$6 - 2n$ oe final answer	2	**B1** for answer $6 - kn$ $(k \neq 0)$ oe or answer $j - 2n$ oe or for correct expression shown in working and then spoilt
7(c)(ii)	$2n^2 - 1$ oe final answer	2	**B1** for 2nd diff = 4 or a quadratic expression or for correct expression shown in working and then spoilt

9(a)		3	**B2** for 5 correct entries including '2' correctly placed at the intersection of the 3 sets
			or **M1** for $k+8-k+3-k+6-k=40-(7+9+11)$ oe or for k, $8-k$, $3-k$, $6-k$, seen correctly placed on diagram with 7, 11 and 9 correctly placed
9(b)	11	**1**	
9(c)	Ø or { }	**1**	

10(c)	0.6934 final answer	3	**B2** for 0.69336… or $3^{-\frac{1}{3}}$ oe or 0.693 or **M1** for $3^{-3^{-x}}$ oe

1(a)(i)	7680	**2**	**M1** for $0.24 \times 32\,000$ oe
1(a)(ii)	34 240	**2**	**M1** for $32\,000 \times \dfrac{100+7}{100}$ oe
1(b)	5306.04	**2**	**M1** for $5000 \times \left(1+\dfrac{2}{100}\right)^3$ oe
1(c)	26.7 or 26.66... to 26.67	**4**	**B3** for 96 or $\dfrac{96}{360}$ oe OR **M3** for $(1-\dfrac{1}{5})\times(1-\dfrac{2}{3})\times 100$ oe or **M2** for $(1-\dfrac{1}{5})$ and $(1-\dfrac{2}{3})$ oe OR **M1** for $360 \div 5\ [\times 4]$ oe **M1** for *their* $288 \div 3\ [\times 2]$
1(d)	33 500	**2**	**M1** for $36\,515 \div \dfrac{100+9}{100}$ oe
1(e)	6525	**4**	**M3** for $\left(\dfrac{65}{45}-\dfrac{63}{45}\right)[A]=290$ oe or **M2** for $\left(\dfrac{13}{9}-\dfrac{7}{5}\right)[A]=290$ oe or **M1** for correct attempt to convert to a common ratio value for Arjun or for $\dfrac{13}{9}-\dfrac{7}{5}$ oe
5(a)	Correct Venn diagram 	**3**	**B2** for 8 or 9 numbers correct or **B1** for 6 or 7 numbers correct
5(b)(i)	41, 43, 47	**1**	**FT** *their* Venn diagram
5(b)(ii)	44, 46, 49, 50	**1**	**FT** *their* Venn diagram
5(c)	0	**1**	**FT** *their* Venn diagram

1(a)(i)	14, 10	2	**M1** for $24 \div (7 + 5)$
1(a)(ii)	$\dfrac{3}{350}$	2	**B1** for correct fraction not in lowest terms
1(a)(iii)	120	1	
1(b)(i)	10.2[0]	2	**M1** for $\dfrac{15}{100} \times 12$ oe or better
1(b)(ii)	45	2	**M1** for $\dfrac{38.25}{1 - \dfrac{15}{100}}$ oe
1(c)(i)	85	2	**M1** for $\dfrac{500 \times 1.7 \times 10}{100}$ oe
1(c)(ii)	203 or 202.5 to 202.6	2	**M1** for $200 \times \left(1 + \dfrac{0.0035}{100}\right)^{365}$
1(c)(iii)	1.9	3	**M2** for $\sqrt[6]{\dfrac{559.78}{500}}$ or **M1** for $500\left(1 + \dfrac{r}{100}\right)^{6} = 559.78$

1(a)	1260	2	**M1** for $15 \times 54 + 25 \times 18$
1(b)	38 800	2	**M1** for $37054 \div \left(1 - \dfrac{4.5}{100}\right)$ oe
1(c)(i)	$15 : 12 : 28$	2	**M1** for correct attempt to find a common multiple for the women oe
1(c)(ii)	216	3	**M2** for $224 \div their \ 28 \times their \ (15 + 12)$ or **M1** for $224 \div their \ 28$
1(d)	55.25	2	**M1** for $8 + 0.5$ or $6 + 0.5$ seen
1(e)	156 or 156.3…	2	**M1** for $\left(1 + \dfrac{1.5}{100}\right)^{30}$

2(a)	$1:5:12$	2	**M1** for $2:10:24$ or $7:35:84$ or $\dfrac{1}{18}:\dfrac{5}{18}:\dfrac{12}{18}$
2(b)(i)	266 and 95	3	**B2** for 266 or 95 or 266 and 95 reversed or **M1** for $\dfrac{114}{6}$
2(b)(ii)	15	2	**M1** for $\dfrac{114-96.9}{114}$ [$\times 100$] oe or $\dfrac{96.9}{114}\times100$
2(c)(i)	2h 50min	1	
2(c)(ii)	636	2	**M1** for $1802 \div$ *their* 2h 50min
7(a)	25 36 10 15 35 51	2	**B1** for 3, 4 or 5 correct
7(b)	n^2	1	
7(c)(i)	92	1	
7(c)(ii)	$\dfrac{1}{2}(n^2-n)$ oe	2	**M1** for $\dfrac{1}{2}(3n^2-n)-n^2$ oe or for final quadratic answer with $\dfrac{1}{2}n^2$ oe or $-\dfrac{1}{2}n^2$ oe but not both
7(d)	$a=\dfrac{1}{2}$, $b=\dfrac{1}{2}$	5	**B2** for 2 correct equations eg $a+b=1$, $8a+4b=6$ or **B1** for 1 correct equation **B2** for one correct value or **M1** (dep on at least B1) for correctly eliminating one variable from two linear equations in a and b OR **B2** for $a=\dfrac{1}{2}$ or **B1** for $6a=3$ or for 3rd difference $=3$ **B2** for $b=\dfrac{1}{2}$ or **M1** for substituting *their* a into a correct equation of first differences

8(f)(i)	$200\left(1+\dfrac{r}{100}\right)^2 = 206.46$ oe	M1	
	$1+\dfrac{2r}{100}+\dfrac{r^2}{100^2}$ oe	M1	
	$r^2 + 200r - 323 = 0$	A1	Correct solution reached with no errors or omissions seen If 0 scored, **SC1** for $200(n)^2 = 206.46$

8(f)(ii)	$\dfrac{-200+\sqrt{200^2-4(1)(-323)}}{2\times 1}$	B2	**B1** for $\sqrt{200^2-4(1)(-323)}$ or $(r+100)^2$ **B1** for $\dfrac{-200+\sqrt{q}}{2\times 1}$ or $r=\sqrt{323+100^2}-100$ OR **B2** for $100\left(\sqrt{\dfrac{206.46}{200}}-1\right)$ or **B1** for $\sqrt{\dfrac{206.46}{200}}$
	1.60 cao final answer	B1	

9(a)(i)		2	**B1** for two correct values Or **B1** 5 outside and total in G = 15 and total in S = 18
9(a)(ii)	$\dfrac{3}{8}$ oe	1	**FT** $\dfrac{their\ 12}{32}$
9(a)(iii)	$\dfrac{2}{5}$ oe	1	**FT** $\dfrac{their\ 6}{15}$
9(b)	96	2	**M1** for $\dfrac{36}{64}=\dfrac{54}{x}$ oe or $36=\dfrac{54}{(54+b)}\times 100$ oe If 0 scored **SC1** for answer 150
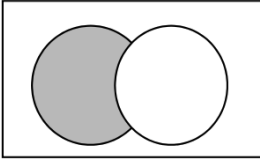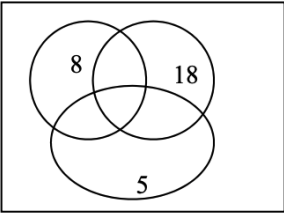
1(a)	9080 cao	3	**B2** for 9078 to 9081… or **M1** for $813 \times$ *their* 11h 10min
1(b)(i)	654 or 653.5…	2	**M1** for $10260 \div 15$ h 42 min oe
1(b)(ii)(a)	21.8 or 21.82 to 21.83	1	
1(b)(ii)(b)	4.58 or 4.59 cao	2	**M1** for $470 \div (10260 \div 100)$ oe or $100 \div$ *their* **(b)(ii)(a)**
1(c)	12.97	1	

3(a)(i)	2210 or 2208 or 2208.2, or 2208.16…	2	**M1** for $2000 \times \left(1 + \dfrac{2}{100}\right)^5$ oe
3(a)(ii)	10.4 or 10.5 or 10.40 to 10.41	2	**M1** for $\dfrac{their\,(a)(i) - 2000}{2000}$ [$\times 100$] or $\dfrac{their\,(a)(i)}{2000} \times 100$ or $\left(1 + \dfrac{2}{100}\right)^5 - 1$ or $\left(1 + \dfrac{2}{100}\right)^5 \times 100$ oe
3(a)(iii)	12	3	**B2** for 11.3 or 11.26 to 11.27 **OR** **M2** for $[2000 \times]\left(1 + \dfrac{2}{100}\right)^{11}$ oe or $[2000 \times]\left(1 + \dfrac{2}{100}\right)^{12}$ oe seen or **M1** for $[2000 \times]\left(1 + \dfrac{2}{100}\right)^{n}$ oe, $n > 5$ oe or for $2000 \times \left(1 + \dfrac{2}{100}\right)^{n} =$ or $>$ or $\geqslant 2500$ oe

3(b)	490 cao	3	**M2** for $p \times \left(1 - \dfrac{4}{100}\right)^{16} = 255$ oe soi by 490.0… or **M1** for $p \times \left(1 - \dfrac{4}{100}\right)^{n} = 255$ oe, $n > 1$ oe

11(a)	A : -3 $17 - 4n$ oe	3	**B1** for -3 **B2** for $17 - 4n$ oe or **B1** for $k - 4n$ oe or $17 - pn$ oe, $p \neq 0$
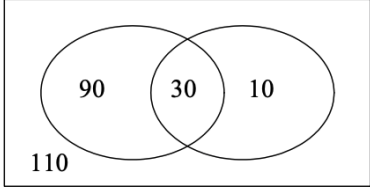
	B : 124 $\quad$ $n^3 - 1$ oe		3	**B1** for 124 **B2** for $n^3 - 1$ oe or **B1** for any cubic
	C : $\dfrac{11}{128}$ $\quad$ $\dfrac{n+6}{2^{n+2}}$ oe		4	**B1** for $\dfrac{11}{128}$ **B3** for $\dfrac{n+6}{2^{n+2}}$ oe or **B2** for 2^{n+2} oe seen or **B1** for 2^k oe or $n+6$ seen
11(b)	$\dfrac{p+1}{2q}$ oe		2	**B1** for $p + 1$ or $2q$ oe

1(a)(i)	$5.101[00\ldots] \times 10^8$ final answer		1	
1(a)(ii)	361 150 800 oe		2	**FT** *their* **(a)(i)** **M1** for $\dfrac{70.8}{100} \times 510\,100\,000$ or for $\dfrac{70.8}{100} \times$ *their* **a(i)**
1(b)(i)	6070 oe		1	
1(b)(ii)	32 000 oe		2	**B1** for figs 32
1(b)(iii)	6.68 or 6.677 …		2	**M1** for $\dfrac{6.41 \times 10^5}{9.6[0] \times 10^6}$ [× 100] oe
1(b)(iv)	1250 or 1248 to 1249 oe		2	**B1** for figs 125 or figs1248 to figs 1249
1(c)(i)	25.1 or 25.08…		2	**M1** for $\dfrac{7.53[\times 10^9] - 6.02[\times 10^9]}{6.02[\times 10^9]}$ oe or $\dfrac{7.53[\times 10^9]}{6.02[\times 10^9]} \times 100$
1(c)(ii)	1.33 or 1.325…		3	**M2** for $\sqrt[17]{\dfrac{7.53[\times 10^9]}{6.02[\times 10^9]}}$ or $\sqrt[17]{1 + \dfrac{their\ \textbf{(c)(i)}}{100}}$ or **M1** for $6.02[\times 10^9] \times p^{17} = 7.53[\times 10^9]$ or $p^{17} = 1 + \dfrac{their\ \textbf{(c)(i)}}{100}$

11A	24	**B1**	
	$5n - 1$ oe	**B2**	**B1** for $5n - k$ or $jn - 1$ oe $j \neq 0$
11B	127	**B1**	
	$n^3 + 2$ oe	**B2**	**B1** for n^3 oe
11C	256	**B1**	
	$4^{(n-1)}$ oe	**B2**	**B1** for 4^k oe

1(a)	473	2	**M1** for $645 \div (11 + 4)$
1(b)	212.5	2	**M1** for 50×4.25
1(c)	31.5 or 31.45 to 31.46	3	**M2** for $54 \div 1\frac{43}{60}$ oe or **M1** for time $=$ 1h 43min or 103 [mins] or $54 \div$ *their* time
1(d)	875	1	
1(e)	10.4 or 10.38 to 10.39	1	
1(f)(i)	30 [×] 70 and 2100	1	
1(f)(ii)	both numbers rounded up oe	1	

9(a)(i)(a)	$\in$	1	
9(a)(i)(b)	$A \cap B$	1	
9(a)(ii)	B or A'	1	
9(b)		1	
9(c)(i)	$3x + 7 = 19$ oe	**M1**	must see 19 and 7
	$3x = 19 - 7$ or better leading to $x = 4$	**A1**	with no errors seen
9(c)(ii)		2	**B1** for 2 correct
9(c)(iii)	$\varnothing$ or { }	1	
9(c)(iv)	15	1	

11(a)(i)	77 243		**2**	**B1** for each
11(a)(ii)(a)	$2n^2 + 5$ oe		**2**	**M1** for a quadratic expression as the answer or **B1** for common 2nd difference of 4
11(a)(ii)(b)	3^{n-1} oe		**2**	**B1** for 3^k oe where k is a linear function of n
11(b)(i)	21		**1**	
11(b)(ii)	11		**3**	**B2** for $(4n+45)(n-11)$ seen or **B1** for $4n^2 + n + 3 = 498$ oe

6(a)			**2**	**B1** for any one correct
6(b)	110		**1**	**FT** *their* 110 in Venn diagram
6(c)	$\dfrac{10}{240}$ oe		**1**	**FT** $\dfrac{their\,10}{240}$

6(d)	$\dfrac{870}{1560}$ oe	3	**M2** for $\dfrac{their30}{40} \times \dfrac{their30-1}{39}$ or **M1** for $\dfrac{p}{q} \times \dfrac{p-1}{q-1}$ $p < q$ or for $\dfrac{their30}{40}$ soi

8(a)	6 nfww	3	**M2** for $\dfrac{2.65-2.50}{2.50}[\times100]$ or for $\dfrac{2.65}{2.50} \times 100$ or **M1** for $\dfrac{2.65}{2.50}$
8(b)	552.5[0]	3	**B2** for 52.5[0] or **M2** for $500 \times \dfrac{1.5}{100} \times 7 + 500$ oe or **M1** for $500 \times \dfrac{1.5}{100} [\times 7]$ oe
8(c)	37.4 or 37.36…	2	**M1** for $\left(1+\dfrac{1.6}{100}\right)^{20}$ oe soi 1.37…
8(d)	4[.00...]	3	**M2** for $\sqrt[22]{\dfrac{2607}{6400}}$ or **M1** for $6400 \times x^{22} = 2607$ oe or better

11	[Total time =]16 h 6 min or 16.1 h	2	**B1** for 22 h 6 min or 22.1h or 966 mins If 0 scored, **SC1** for 9 h 41 min
	[Distance to airport in New York =] 16.5	2	**M1** for 18×55
	[Arc length =] 6200 or 6199 to 6200. …	3	**M2** for $\dfrac{55.5}{360} \times 2 \times \pi \times 6400$ or **M1** for $\dfrac{55.5}{360}$ or $2 \times \pi \times 2400$
	[Distance Geneva to Chamonix =] 104	2	**M1** for 65×1.6 or 65×96 oe
	392 to 393	2	**M1** for $\dfrac{6316 \text{ to } 6322.4}{their16.1}$ Must be correct value in numerator

1(a)	16.5 or 16.49...	3	**M2** for $\dfrac{1.13-0.97}{0.97}$ [×100] oe or $\dfrac{1.13}{0.97}\times 100$ oe or **M1** for $\dfrac{1.13}{0.97}$ oe
1(b)(i)	35	2	**M1** for $60\div(5+7)$
1(b)(ii)	140	1	
1(c)	$1.26 final answer	3	**B2** for 1.259... or 1.26 but not as final answer or **M1** for $2.25\div 0.9416$ If 0 scored, **SC1** for 1.13×0.9416
1(d)	15[.0...]	3	**M2** for $\sqrt[21]{\dfrac{58000}{1763000}}$ oe or **M1** for $58000=1763000\,(k)^{21}$
1(e)	1239.75	2	**B1** for $43+0.5$ or $28+0.5$ oe seen

11(a)	40 54 26 34	4	**B1** for each
11(b)	n^2+3n or $n(n+3)$ oe	2	**B1** for a quadratic expression or for 2nd common difference 2 (at least 2 shown) or for 2 correct equations seen or for subtracting n^2
11(c)	100	2	**M1** for *their* **(b)** = 10300 seen
11(d)	$[a=]\ \dfrac{1}{2}$ oe and $[b=]\ \dfrac{5}{2}$ oe	2	**B1** for each or **M1** for one correct equation or for 2nd difference = 1 soi (at least 2 shown)

1(a)(i)	6h 27 mins	2	**B1** for answer ....h 27 mins
1(a)(ii)	150 km/h	3	**M2** for $\dfrac{90}{36} \times 60$ or **M1** for $\dfrac{90}{their \text{ time}}$ or **B1** for 36 [mins] seen
1(a)(iii)	780	4	**M3** for $\left(90 \times \dfrac{35}{3600}\right) \times 1000 - 95$ oe or **M2** for $\left(90 \times \dfrac{35}{3600}\right) \times 1000$ oe or **B1** for figs 875 or **M1** for $90 \times \dfrac{35}{3600}$ seen or for $90 \times \dfrac{1000}{3600}$ oe If 0 scored, **SC1** for *their* distance (> 95) – 95
1(b)(i)	7 : 5	1	
1(b)(ii)	66.7 or 66.66 to 66.67	3	**M2** for $\dfrac{140 - 84}{84}$ [× 100] oe or for $\dfrac{140}{84} \times 100$ oe or **M1** for $\dfrac{140}{84}$ oe
1(b)(iii)	24 576	5	**M4** for complete method, $40 \times 60 + 0.7 \times 220 \times 84 + 0.3 \times 220 \times 140$ oe OR **B1** for 40 [children] **M1** for $0.7 \times 220 \times 84$ oe **M1** for $0.3 \times 220 \times 140$ oe **B1** for 2400 or 12936 or 9240 nfww
1(c)	3.5×10^5 nfww	3	**M2** for $3.08 \times 10^5 \div \left(\dfrac{100 - 12}{100}\right)$ oe or **M1** for 3.08 [× 10^5] associated with (100–12)%

10(a)(i)	3, –1	2	**B1** for each
10(a)(ii)	23 – 4n oe final answer	2	**M1** for $k - 4n$ or $23 - jn$ ($j \neq 0$)
10(a)(iii)	22	2	**M1** for *their* **(a)(ii)** = –65
10(b)	23	2	**B1** for 37 or 60

2(a)	[Ali] 2700 [Mo] 2100	3	**B2** for one correct or for correct values reversed or **M1** for $600 \div (9 - 7)$ or for any equation that would lead to an answer of 300, 2700 or 2100, or 4800 (for the total)
2(b)	11	3	**M2** for $\dfrac{220 - 195.8}{220}[\times 100]$ or for $[100 -]\dfrac{195.8}{220} \times 100$ or **M1** for $220 - 195.8$ or for $\dfrac{195.8}{220}$ or a correct implicit equation for percentage reduction or for $\dfrac{195.8 - 220}{220}$
2(c)	84	3	**M2** for $\dfrac{63}{1 - \dfrac{25}{100}}$ oe or **M1** for associating 63 with $(100 - 25)\%$ or a correct implicit equation for the original price.
3(a)	662.45	2	**M1** for $600 \times \left(1 + \dfrac{2}{100}\right)^5$ oe
3(b)(i)	800	2	**M1** for $x\left(1 + \dfrac{5}{100}\right)^2 = 882$ oe or **SC1** for answer 82
3(b)(ii)	5 nfww	2	**M1** for trial with $882 \times \left(1 + \dfrac{5}{100}\right)^n$ with $n > 1$

10(a)	− 7 13 − 4n oe	11	**B1** **B2** or **B1** for 13 − kn ($k \neq 0$) or for $k − 4n$
	36 $(n + 1)^2$ oe		**B1** **B2** or **B1** for any quadratic
	125 n^3 oe		**B1** **B1**
	128 2^{n+2} oe		**B1** **B2** or **B1** for 2^k oe
10(b)	...., ..., 6, 10, 16 .... , 3, 4, 7, ... 2, ..., 1, 0, ...	3	**B1** for each correct row
10(c)(i)	$\dfrac{q}{p + q}$	1	
10(c)(ii)	$\dfrac{18}{29}$	1	

1(a)(i)	5 : 6	1	
1(a)(ii)	$2.0736[0] \times 10^5$ final answer	3	**B2** for 207360 oe or **M1** for $16 \times 18 \times 720$
1(b)(i)	26780	2	**M1** for $18540 \div 9$ soi
1(b)(ii)	1.36	2	**M1** for 0.85×1.6 oe or **B1** for 0.51 or 51
1(c)	66.7 or 66.66 to 66.67	5	**M4** for $\dfrac{(2.3 - 1.5 \times 0.92)}{1.5 \times 0.92}[\times 100]$ oe or $\dfrac{2.3 \times 100}{1.5 \times 0.92}$ oe **OR** **Working in euros** **B2** for [€]1.38 or **M1** for $1.5[0] \times 0.92$ **M2dep on B2 or M1** for $\dfrac{2.3 - their\,1.38}{their\,1.38}[\times 100]$ oe or $\dfrac{2.3 - their\,1.38}{their\,1.38} \times 100$ oe or **M1** for $2.3 - their\,1.38$ or $\dfrac{2.3}{their\,1.38}$ **OR** **Working in dollars** **B2** for [\$]2.50 or **M1** for or $2.3[0] \div 0.92$ **M2dep on B2 or M1** for $\dfrac{their\,2.5 - 1.5}{1.5}[\times 100]$ oe or $\dfrac{their\,2.5}{1.5} \times 100$ or **M1** for $their\,2.5 - 1.5$ or $\dfrac{their\,2.5}{1.5}$

9(a)	171 or 171.0…	3	**M2** for $\dfrac{7.6}{160} \times 60 \times 60$ oe or **M1** for $\dfrac{7.6}{160}$ or $\dfrac{7.6}{2\frac{2}{3}}$ or $\dfrac{7.6}{2\min 40\sec}$ If 0 scored, **SC1** for answer 189 or 188.6 to 188.7
9(b)(i)	77 [min] 20 [s]	4	**M3** for $\dfrac{32}{12} \times 29$ oe or **B2** for 4640 or 1.29 or 1.288 to 1.289, $\dfrac{58}{45}$ oe or 32 laps or 29 laps or **M2** for $2^5 \times 5 \times 29$ oe or **M1** for $2\,\text{m}\,40\,\text{sec} \div (2\,\text{m}\,40\,\text{sec} - 2\,\text{m}\,25\,\text{sec})$ soi for $2\,\text{m}\,25\,\text{sec} \div (2\,\text{m}\,40\,\text{sec} - 2\,\text{m}\,25\,\text{sec})$ soi or for an attempt to find LCM or 23 200 seen or correctly find prime factors of 145 or 160 or for $\dfrac{7.6}{145}$ or $\dfrac{7.6}{2\frac{5}{12}}$ or $\dfrac{7.6}{2\min 25\sec}$ oe, provided SC1 not earned in part (a)
9(b)(ii)	220.4	2	**M1** for *their* (b)(i) ÷ 2min 40 sec [× 7.6] oe or *their* (a) × *their* (b)(i) ÷ 60 oe

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1(a)(i)	1254	2	**M1** for $342 \div 3$
1(a)(ii)	27.3 or 27.27…	1	
1(b)	867	2	**M1** for $1020 \times \dfrac{15}{100}$ oe or $1020 \times \left(1 - \dfrac{15}{100}\right)$ oe
1(c)	4.5[0]	3	**M2** for $\dfrac{79.5[0]}{100 + 6}[\times 6]$ oe or $\dfrac{79.5[0]}{100 + 6} \times 100$ oe or **M1** for $79.5[0]$ associated with 106[%]
1(d)	22.6 or 22.58… nfww	4	**M1** for $\dfrac{45}{20}$ or better and **M2** for $\dfrac{60 + 45}{\text{their } 2h\,24\,min + \text{their } \frac{45}{20}}$ or **M1** for *their* $\dfrac{45}{20}$ + *their* 2h 24min
1(e)	91.6[0] to 91.61	3	**M2** for $480 \times \left(1 + \dfrac{2.1}{100}\right)^4 - 430$ oe OR **M1** for $480 \times \left(1 + \dfrac{2.1}{100}\right)^4$ oe **A1** for 522, 521.6[0] to 521.61
1(f)	112.8125	2	**B1** for 2.5 or 9.5 seen

1(a)(i)	23.27 final answer	2	**M1** for 9×2.97 soi
1(a)(ii)	2.75 final answer	3	**M2** for $2.97 \div \dfrac{108}{100}$ oe or **M1** for 108[%] associated with 2.97 oe
1(b)	12.4[0] or 12.41 to 12.42	2	**M1** for $35 \div 0.0153$ oe If 0 scored, **SC1** for answer 0.19
1(c)	70 nfww	3	**M2** for $(600 + 2.5) \div (9 - 0.5)$ or **B1** for one of $600 + 2.5$ or $9 - 0.5$ seen

11(a)	25 9 16	3	**B1** for each
11(b)(i)	$(n-1)^2$ oe	2	**B1** for any quadratic of form $[1]n^2[+bn+c]$
11(b)(ii)	$n+3$ oe	1	
11(c)	25	2	**M1** for *their* $(n-1)^2 = 576$
11(d)(i)	$n^2 - 3n - 2$ final answer	3	**M1** for *their* $(n-1)^2 - their(n+3)$ oe or 2nd diff = 2 soi **B1** for $n^2 - n - n + 1$ or better or $-n-3$ or for expression of form $n^2 - 2n - n + k$ or correct expression not in simplest form
11(d)(ii)	808 cao	2	**M1** for substituting 30 in *their* **(d)(i)**
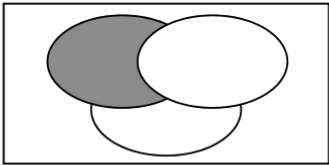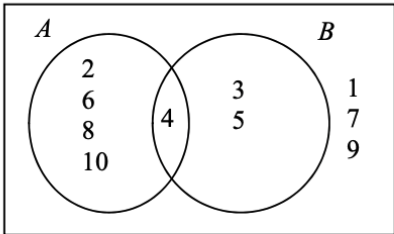
1(a)	$\dfrac{9}{9+7+4} \times 680$	1	
1(b)	238 136	3	**B2** for 238 or 136 or **M1** for $\dfrac{7}{9+7+4} \times 680$ oe or $\dfrac{4}{9+7+4} \times 680$ oe seen
1(c)	272	2	**M1** for $306 \div 1.125$
1(d)	1.37	3	**M2** for $(17.56 - 5 \times 2.69) \div 3$ or **M1** for $17.56 - 5 \times 2.69$ or **B1** for 13.45 [cost of apples]
1(e)	40.8[0]	3	**3FT** for $0.3 \times their$ 136 from part **(b)** or **M2** for *their* $136(\frac{1}{2} + \frac{1}{5})$ or better or **M1** for *their* $136 \times \frac{1}{2}$ or *their* $136 \times \frac{1}{5}$ or **B1** for 68 or 27.2 or $\frac{3}{10}$ or 0.3 seen

3(a)	6.06 or 6.060 to 6.061	3	**M2** for $\dfrac{82500 - 77500}{82500}[\times 100]$ oe or **M1** for $\dfrac{77500}{82500}[\times 100]$ soi
3(b)	13 674 cao	3	**M1** for $12000\left(1 + \dfrac{2.2}{100}\right)^6$ **A1** for 13673.7...

10(a)	75	3	**M2** for 79.5 ÷ 1.06 oe or **M1** for 79.5 associated with 106 [%]
10(b)	962.5 cao	2	**B1** for 35 or 27.5 seen
10(c)(i)	16	1	
10(c)(ii)	50	1	
10(c)(iii)	$\dfrac{4}{50}$ oe	2	**FT** *their* **(c)(ii)** for 1 or 2 marks **B1** for $\dfrac{4}{k}$, $k > 4$ or $\dfrac{k}{their\,50}$, $k < 50$
10(c)(iv)	19	1	

12(a)	18 28	2	**B1** for each
12(b)	$3n + 3$ oe	2	**B1** for $3n + k$ oe or $cn + 3$ oe $c \neq 0$
12(c)	45	2	**M1** for identifying 7th pattern or **M1** for *their* $(3n + 3) = 24$
12(d)	$[a =]\dfrac{3}{2}$ oe $[b =]\dfrac{13}{3}$ oe	6	**M1** for any correct substitution e.g. $\dfrac{1}{6}(2)^3 + 2^2 a + 2b$ **A1** for one of e.g. $\dfrac{1}{6} + a + b = 6$ oe $\dfrac{8}{6} + 4a + 2b = 16$ oe $\dfrac{27}{6} + 9a + 3b = 31$ oe $\dfrac{64}{6} + 16a + 4b = 52$ oe **A1** for another of the above **M1** for correctly eliminating one variable from *their* equations **A1** for $a = \dfrac{3}{2}$ **A1** for $b = \dfrac{13}{3}$ oe

1(a)(i)	85	1	
1(a)(ii)	455	2	**M1** for $260 \div 20 \times 35$ oe
1(a)(iii)	61	3	**B2** for 61.5… seen or **M1** for $2000 \div 650$ soi or for $\dfrac{x}{2000} = \dfrac{20}{650}$ oe or other attempt at scaling up with 650 or for $650 \div 20$ oe
1(b)(i)	40	3	**M2** for $\dfrac{1.89 - 1.35}{1.35}$ [$\times 100$] oe or $\dfrac{1.89}{1.35} \times 100$ oe or **M1** for oe $\dfrac{1.89}{1.35}$ [$\times 100$] soi
1(b)(ii)	1.75 nfww	3	**M2** for $1.89 \div \left(\dfrac{100+8}{100}\right)$ or better or **M1** for 1.89 associated with 108 [%]
1(c)	10.1 or 10.06…	3	**M2** for $\sqrt[3]{\dfrac{20.8}{15.6}}$ oe or **M1** for $15.6 \times k^3 = 20.8$ oe
1(d)(i)	14:15	3	**B2** for correct unsimplified 3 term ratio A: B: C or correct unsimplified two term ratio A : C or **M1** for attempt to find common multiple of 4 and 10 or other common value for B or for $7 \times \dfrac{4}{10}$ oe or $3 \times \dfrac{10}{4}$ oe
1(d)(ii)	147	3	**M2** for $\dfrac{45}{15}\left(14 + 20\,[+15]\right)$ oe or $45 \div 3 \times 4 + (45 \div 3 \times 4) \div 10 \times 7\,[+\,45]$ or **M1** for $45 \div 3$ oe or $45 \div$ *their* **(d)(i)** value for C shown

1(a)(i)	13.5		3	**M2** for $\dfrac{45.4[0]-40}{40}$ [× 100] or $\dfrac{45.4[0]}{40}\times 100$ or **M1** for $\dfrac{45.4[0]}{40}$ [× 100]
1(a)(ii)	35.5[0]		3	**M2** for $42.6[0]\div\left(1+\dfrac{20}{100}\right)$ or better or **M1** for recognising 42.6[0] as 120[%]
1(b)	150 cao		2	**M1** for $\dfrac{500\times 2\times 15}{100}$ oe
1(c)(i)	7800 cao		3	**B2** for 7790 or 7785 to 7786 or **M1** for $21000\times\left(1-\dfrac{18}{100}\right)^5$ oe isw If 0 or 1 scored, **SC1** for *their* 7785… seen and rounded correctly to nearest 100
1(c)(ii)	9[.00…]		3	**M2** for $\sqrt[12]{\dfrac{42190}{15000}}$ or better or **M1** for $15000\left(1+\dfrac{x}{100}\right)^{12}=[42190]$

1(a)(i)	2.25 final answer		2	**M1** for $\dfrac{3}{5+3}$ or $\dfrac{6}{5+3}$ oe
1(a)(ii)	37.5		1	**FT** *their* $\dfrac{\textbf{(a)(i)}}{6}\times 100$
1(a)(iii)	5.5[0] or 5.499 to 5.500		2	**M1** for $6\div 1.091$
1(b)	21		3	**M2** for $15\times\sqrt{\dfrac{352.8}{15\times 12}}$ oe or **SC2** for answer 16.8 or **M1** for $\sqrt{\dfrac{352.8}{15\times 12}}$ or $\sqrt{\dfrac{15\times 12}{352.8}}$ seen or **M1** for a correct implicit statement for the length
1(c)	525		3	**M2** for $\dfrac{483}{100-8}$[×100] oe or **M1** for 483 associated with 92 [%]

6(a)(iv)	Correct shading 	1	
6(b)(i)	Fully correct Venn diagram 	4	**B1** for each correct region
6(b)(ii)	3 4 5	1	**FT** *their* **(b)(i)**

1(a)(i)	1200	2	**M1** for $1962 \div 1.635$
1(a)(ii)	1667.7[0] final answer	2	**M1** for $1962 \times (1 - \dfrac{15}{100})$ oe or **B1** for 294.3[0] If 0 scored, **SC1** for answer 1020
1(a)(iii)	275	2	**M1** for $220 \div$ *their* $(5 - 1)$ soi
1b(i)	165	3	**M2** for $\dfrac{9752 - 3680}{3680}[\times 100]$ oe or $\dfrac{9752}{3680} \times 100$ oe or **M1** for $\dfrac{9752}{3680}$ or $9752 - 3680$
1b(ii)	51 200	3	**M2** for $\dfrac{74240}{100 + 45}[\times 100]$ oe or **M1** for 74 240 associated with 145[%] oe

2(a)(i)	$\dfrac{240}{(23 + 25)} \times 23$	**M1**	
2(a)(ii)	$11 : 10$	2	**M1** for $110 : 100$ or better or **SC1** for $10 : 11$, following boys 100, girls 110

2(a)(iii)	276	2	**M1** for $240 \times \left(1 + \dfrac{15}{100}\right)$ oe or **B1** for 36 seen
2(a)(iv)	150	3	**M2** for $\dfrac{240}{100 + 60}$ [$\times$ 100] oe or **M1** for evidence of 160[%] associated 240
2(b)	464 000	3	**M1** for $256\,000 \times \left(1 + \dfrac{2}{100}\right)^{30}$ oe **A1** for 463 700 to 463 710 **B1** for *their* more accurate answer seen and rounded to nearest 1000
2(c)	4.5[0]	3	**M2** for $[x =]\ \sqrt[32]{4.09}$ oe or **M1** for $(x)^{32} = 4.09$ oe If 0 scored, **SC2** for answer 3.6 or 3.59 or 3.588… or **SC1** for $\sqrt[32]{3.09}$ or 1.0358 to 1.036 seen

10(a)	$\dfrac{8}{15}$	**B1**	
	$\dfrac{n+2}{2n+3}$ oe	**B2**	**B1** for $n + 2$ as numerator or $2n + 3$ as denominator
10(b)(i)	$1 - 2n$ oe	2	**B1** for $-2n + k$ oe or $pn + 1\ (p \neq 0)$ oe
10(b)(ii)	$n^3 + 1$ oe	2	**M1** for cubic expression

1	**(a)**	22.9 or 22.85 to 22.86	2	**M1** for $\dfrac{8}{10 + 17 + 8}$ [$\times$ 100] oe
	(b)	$5635 \times \dfrac{17}{10 + 17 + 8}$ or better [= 2737]	2	**M1** for $\dfrac{5635}{(10 + 17 + 8)}$
	(c)	5000	3	**M2** for $5635 = k\left(1 + \dfrac{2.42}{100}\right)^5$ oe or **B1** for $\left(1 + \dfrac{2.42}{100}\right)$
	(d)	9950	2	**M1** for 2×2500 or 3×1650
	(e)	1.98 final answer	2	**B1** for 1.976 or 1.98 not final answer or **M1** for 130×0.0152

1(a)(i)	275.31	2	**M1** for $90 \times 23.15 + 1885 \times 13.5$ oe
1(a)(ii)	3202	3	**M2** for $\dfrac{198.16 - 90 \times 0.245}{0.055}$ oe **M1** for 90×0.245 or 90×24.5 oe
1(b)	17.[0] or 17.00 to 17.01	2	**M1** for $13.5 \times \left(1 + \dfrac{8}{100}\right)^3$
1(c)(i)	40	3	**M2** for $\dfrac{7.7 - 5.5}{5.5}$ [$\times 100$] oe or $\dfrac{7.7}{5.5} \times 100$ or **M1** for $\dfrac{7.7}{5.5}$ oe
1(c)(ii)	11.9 or 11.86 to 11.87	3	**M2** for $\sqrt[3]{\dfrac{7.7}{5.5}}$ oe or **M1** for $5.5 \times x^3 = 7.7$ oe
1(d)	150 [million] oe	2	**M1** for 390 [million] $\div (5 + 2 + 6)$
1(e)	250 nfww	3	**M2** for $258.25 \div ((100 + 3.3) \div 100)$ or **M1** for 258.25 associated with 103.3[%]

9(a)(i)	5 and 13	1	
9(a)(ii)	$8n - 3 = 203$	**M1**	Evaluation of 25th or 26th term with supporting evidence or explanation
	25.75 or $25\dfrac{3}{4}$	**A1**	Second evaluation of 25th or 26th terms with supporting evidence or explanation If zero scored, **SC1** for 25.75 or 197 and 205 with partial evidence or explanation
9(b)(i)	$6n + 7$ oe final answer	2	**B1** for $6n + c$ or $kn + 7$ $k \neq 0$
9(b)(ii)	$n^2 + n + 2$ oe final answer	2	**B1** for a quadratic expression or second difference = 2
9(c)	[$y =$] 10	2	**M1** for $5(20 - y) = 50$
	[First term =] 14	2	**M1** for $5(x - \textit{their } y) = 20$ or for $20 \div 5 + \textit{their } y$

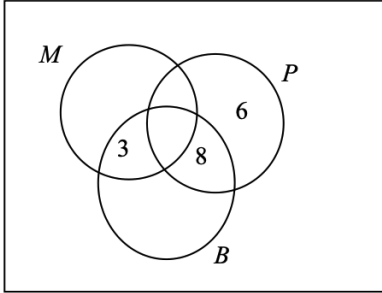|			
1(a)(i)	$600 \div (11+9) \times 11$ [=330] with no errors seen	M1	Could be in separate steps
1(a)(ii)	270	1	
1(b)(i)	372 cao nfww	3	B2 for answer 371.7… or M1 for $330 \times \left(1+\dfrac{1.5}{100}\right)^8$ oe not spoiled After zero scored, SC1 for answer 42 or 41.7…
1(b)(ii)	12.6 or 12.7 or 12.63 to 12.73	2	M1 for $\dfrac{their\,(b)(i)-330}{330}$ or $\dfrac{their\,(b)(i)}{330}\times100$ soi by 112.7 or 113 After zero scored, SC1 for answer 12%
1(c)(i)	$\dfrac{99}{280}$ cao final answer	1	
1(c)(ii)	27.5[0]	3	M2 for $24.75 \div \dfrac{100-10}{100}$ oe or M1 for recognising 24.75 as 90[%] oe
1(d)(i)	32 cao	2	M1 for $\left(1-\dfrac{20}{100}\right)\left(1-\dfrac{15}{100}\right)[x]$oe or for $0.15 \times 0.8\,[x]$ oe
1(d)(ii)	13 cao	2	M1 for $\left(1-\dfrac{20}{100}\right)\left(1-\dfrac{15}{100}\right)\times x = 40.84 - 32$ oe seen or for $their\,(d)(i) + \left(1-\left(\dfrac{their\,(d)(i)}{100}\right)\right)x = 40.84$ oe

1(a)(i)	9550	1	
1(a)(ii)	23 158 750	2FT	FT *their* (a)(i) × 2425 correctly evaluated M1 for *their* lower bound × 2425
1(a)(iii)	23 160 000	1FT	FT *their* (a)(ii) rounded to 4 sf
1(a)(iv)	2.316×10^7	1FT	FT *their* (a)(iii) or *their* (a)(ii) rounded to 3sf or more and in standard form
1(b)	520 nfww	3	M2 for $546 \times \dfrac{100}{(100+5)}$ oe or M1 for 105[%] associated with 546 oe
1(c)	3380 or 3376 to 3377	2	M1 for $3\,000 \times \left(1+\dfrac{3}{100}\right)^4$ oe

10(a)		**4**	All 8 regions correct **M3** for 6 or 7 regions correct **M2** for 4 or 5 regions correct **M1** for 3 regions correct
10(b)(i)	$\notin$	**1**	
10(b)(ii)	$\varnothing$	**1**	
10(c)	21, 23, 24, 29	**2FT**	Correct or **FT** **SC1** for 1 omission or 4 correct and 1 extra
10(d)(i)	5	**1FT**	Correct or **FT** if less than 10
10(d)(ii)	9	**1FT**	Correct or **FT** if less than 10
10(e)	$\subset$ or $\subseteq$	**1**	

11	64 $(n+3)^2$ oe final answer	**1, 2**	**M1** for a quadratic expression seen or second differences 2
	17 $3n+2$ oe final answer	**1, 2**	**B1** for $3n+k$ (any k) or $kn+2$ $(k \neq 0)$
	47 $(n+3)^2 - (3n+2)$ oe isw	**1, 2FT**	**FT** *their* difference expressions $A - B$ **M1** for expression $an^2 + bn + c$ seen or second differences 2
	$\dfrac{7}{6}$ $\dfrac{n+2}{n+1}$ oe final answer	**1, 2**	**B1** for $\dfrac{n+k+1}{n+k}$ seen

1(a)	2915	2	**M1** for $10\,494 \div (13 + 5)$ oe
1(b)	1056	2	**M1** for $384 \div (10 - 6)$ oe
1(c)(i)	52.2 or 52.17…	2	**M1** for $20 \div 23$ or 20×60 or $23 \div 60$ isw If zero scored, **SC1** for answer 52.6 (from use of 0.38)
1(c)(ii)	63[.0] or 63.03 to 63.05…	5	**M4** for $\dfrac{their\ 52.17... - 32}{32} \times 100$ oe or **M3** for $\dfrac{their\ 52.17... - 32}{32}$ oe or $\dfrac{their\ 52.17...}{32} \times 100$ oe OR **B2** for $\dfrac{5}{8}$ [hours] oe or 37.5 [minutes] or **M1** for $20 \div 32$ or better and **M2** for $\dfrac{their\ 37.5 - 23}{23} \times 100$ oe or **M1** for $\dfrac{their\ 37.5 - 23}{23}$ or $\dfrac{their\ 37.5}{23} \times 100$
1(d)	0.06 final answer nfww	3	**M1** for $11.99 \div 0.9276$ or 12.99×0.9276 **A1** for 12.93 or 12.925 to 12.926
1(e)	9750	3	**M2** for $7605 \div \left(1 - \dfrac{22}{100}\right)$ oe or **M1** for $(100 - 22)[\%]$ correctly associated with 7605 seen

6(a)	18　22　$4n + 2$ oe 17　26　$n^2 + 1$ oe	6	**B2** for 18, 22, 17, 26 or **B1** for two or three correct values AND **B2** for $4n + 2$ oe or **B1** for $4n + k$ oe or $pn + 2$ ($p \neq 0$) AND **B2** for $n^2 + 1$ oe or **B1** for $n^2 + k$ oe
6(b)	242	1	**FT** *their* $4n + 2$ provided a linear expression
6(c)	15	1	
6(d)	3	2	**M1** for $2 \times 1^2 + 2 \times 1 + q = 7$ oe

1(a)(i)	4 : 5	1	
1(a)(ii)	4 : 5	1	
1(a)(iii)	3 : 4	2	**B1** for 12 : 16 or answer 4 : 3
1(b)(i)	26.8 or 26.79…	3	**M2** for $\dfrac{15600-11420}{15600}[\times 100]$ or $\dfrac{11420}{15600}\times 100$ or **M1** for $\dfrac{11420}{15600}$
1(b)(ii)	16 000 nfww	3	**M2** for $15600\times\dfrac{100}{100-2.5}$ oe or **M1** for 15600 associated with 97.5[%] seen
1(c)	1.6 or $\dfrac{8}{5}$	2	**M1** for $\dfrac{200\times x\times 15}{100}=48$ oe or **M1** for figs 16
1(d)	2.5 or $\dfrac{5}{2}$ cao nfww	3	**B2** for 2.49[9…] or 102.4[99…] or 1.024[99…] or 2.50 or 102.5 or 1.025 or **M2** for $\sqrt[10]{\dfrac{256}{200}}$ oe or **M1** for $256=200(x)^{10}$ seen

3(a)(i)	1890	2	**M1** for 126 ÷ 4 [× 60] oe If zero scored, **SC1** for answer 31.5
3(a)(ii)	103.95	4	**M3** for $0.5 \times \left(\dfrac{44}{60} + \dfrac{55}{60} \right) \times 126$ oe or **SC3** for figs 10395 or figs 104 or **M2** for two correct area methods or for a full method without minutes to hours conversion or **M1** for one correct area with or without minutes to hours conversion
3(b)(i)	126 × 1000 ÷ (60 × 60)	1	
3(b)(ii)	46.3 or 46.28 to 46.29	3	**M2** for (1400 + 220) ÷ 35 oe or **M1** for distance ÷ speed or 1400 + 220
3(c)	180 nfww	4	**B3** for final answer 3 OR **M3** for $\dfrac{217.5}{72.5} \times 60$ oe or **M2** for 217.5 ÷ 72.5 oe or $\dfrac{210 \text{ to } 220}{72.5} \times 60$ or $\dfrac{217.5}{72 \text{ to } 74} \times 60$ or **M1** for 217.5 or 72.5 seen or $\dfrac{215}{73} \times 60$

10(a)(i)	$2^2 \times 3^2 \times 5$ oe	2	**M1** for 3 correct prime factors in a tree or table seen before the first error or for 2, 3, 5 identified
10(a)(ii)	540	2	**M1** for $2^2 \times 3^3 \times 5$ or 2×3^3 shown or answer 540k

10(b)	$X = 8575$ $Y = 6125$	4	**B3** for $X = 8575$ or $Y = 6125$ or **B2** for $a = 5$ or $b = 1$ soi or **B1** for $1225 = 5^2 \times 7^2$ or $42\,875 = 5^3 \times 7^3$ or **M1** for $a^2 \times 7^2 [= 1225]$ or $a^3 \times 7^{b+2} [= 42\,875]$

1	(a)	$\dfrac{8}{8+15+9}\times 640$ oe	1	With no errors seen
	(b)	300 and 180	2	**B1** for each or **SC1** for answers reversed
	(c)	10 nfww	2	**M1** for $160 \div 15.25$ implied by 10.5 or 10.49... nfww
	(d)	$\dfrac{7}{24}$	3	**M1** for $\dfrac{3}{8}+\dfrac{1}{3}$ oe **M1dep** on previous **M1** for $1 - their\,(\dfrac{3}{8}+\dfrac{1}{3})$ oe

3	(a)	(i)		3	**B1** for each
		(ii)	46	1FT	**FT** $29 + their$ 3 values from **(a)**
		(iii)	11	1	
		(iv)	$\dfrac{7}{19}$ oe	2	**M1** for $\dfrac{n}{16+their\,3}$ $(0 < n < (16 + their\,3))$ or $\dfrac{4+their\,3}{k}$ $(k > (4 + their\,3))$
	(b)	(i)	$\dfrac{9}{200}$ or 0.045	1	
		(ii)	10800	3	**M2** for ½ (900 + 1500) × 9 oe or **M1** for method of finding a relevant area
		(iii)	7.2	1FT	**FT** ($their$ 10800) ÷ 1500

5	(a)	6250	3	**M2** for $\dfrac{6000}{100-4}\times 100$ oe or **M1** for 6000 associated with 96 [%]
	(b)	4441	3	**B2** for 4441.1 to 4441.2 or 4440 or **M1** for $\dfrac{6000}{1.351}$

	(c)	1.58 or 1.581…	5	**M1** for $6000\times\left(1+\dfrac{1.5}{100}\right)^{8}$ oe **A1** for 6758.95…..... or 6758.96 to 3 sf or better or 758.95 or 758.96 rounded or truncated to 3 sf and **M2** for $\{their(6000\times 1.015^{8})-6000\}\times\dfrac{100}{6000\times 8}$ oe or **M1** for $\dfrac{6000\times r\times 8}{100}$ oe

1	(a)	(i)	48	2	**M1** for $\dfrac{72}{3}$
		(ii)	32.4[0]	1	
		(iii)	$\dfrac{13}{30}$	2	**M1** for $\dfrac{72 - their(ii) - 8.4}{72}$ oe
		(iv)	24	3	**M2** for $\dfrac{19.2}{0.8}$ oe or **M1** for recognising 19.2 is 80%
	(b)		660	3	**M2** for $\dfrac{550 \times 2 \times 10}{100} + 550$ oe or **M1** for $\dfrac{550 \times 2 \times 10}{100}$ oe
	(c)		663.9[0]	2	**M1** for 550×1.019^{10} oe
	(d)		1.5[0]	3	**M2** for $\sqrt[10]{\dfrac{638.3[0]}{550}}$ oe or **M1** for $550 \times m^{10} = 638.3[0]$

1	(a)	(i)	12 45 [pm]	2	**B1** for 20 45 seen or 8 45 pm seen or [0]1 35 seen
		(ii)	788 or 787.8 to 788.1	2	**M1** for 8800 ÷ 11h 10 mins oe
	(b)	(i)	4230[.00]	2	**M1** for 2350 ÷ 5 oe
		(ii)	22.2 or 22.2…	1	
	(c)	(i)	3808 final answer	2	**M1** for $2240 \times \dfrac{100 + 70}{100}$ oe
		(ii)	800	3	**M2** for $2240 \div \dfrac{100 + 180}{100}$ oe or **M1** for 2240 associated with 280%
	(d)	(i)	1130	4	**M3** for (826.5[0] – 12 × (28 + 6.5[0])) ÷ 1.25 seen or **M2** for 826.5[0] – 12 × (28 + 6.5[0]) seen or **M1** for 12 × (28 + 6.5[0]) seen
		(ii)	$146.9[0] final answer	2FT	**FT** *their*(d)(i) × 0.13 correctly evaluated If answer not exact to at least 3 sf or better **M1** for *their* (d)(i) ÷ 10 × 1.3

1	**(a)**	**(i)**	36 600	3	**M2** for $6100 \div 2 \times (2 + 7 + 3)$ oe or **M1** for $6100 \div 2$ soi
		(ii)	$16\dfrac{2}{3}$ or 16.7 [16.66 to 16.67]	1	
	(b)		1 231 708 final answer nfww	5	**M4** for $5964 \times 15 + 28400 \times 35 + 8236 \times 18$ or **M3** for 5964×15 **and** 28400×35 or for $5964 \times 15 + 42600 \times$ *their* decimal $\dfrac{2}{3}$ $\times 35 + (42600 - 5964 - 42600 \times$ *their* decimal $\dfrac{2}{3}) \times 18$ or **M2** for 5964×15 **or** 28400×35 or for $42600 \times$ *their* decimal $\dfrac{2}{3} \times 35$ or **M1** for 0.14×42600 or $42600 \div 3 \times 2$
	(c)		27.2[0] nfww	5	**M2** for $23.80 \div 0.7$ oe or **M1** for 23.80 associated with 70% oe and **M2** for *their* $(23.80 \div 0.7) \times 0.8$ or **M1** for *their* $(23.80 \div 0.7) \times 0.2$

10	**(a)**		10 15 15 21 35 48	6	**B1** for each correct entry
	(b)	**(i)**	3	2	**M1** for any correct substitution in $n^2 + 4n + p$ = number of tiles eg $2^2 + 4(2) + p = 15$
		(ii)	143	1FT	**FT** $140 +$ *their* (b)(i)
	(c)		$a = \dfrac{1}{2}$ oe $b = \dfrac{3}{2}$ oe nfww	5	**B1** for a correct simplified equation e.g. $a + b + 1 = 3$, $4a + 2b + 1 = 6$, $9a + 3b + 1 = 10$ etc **B1** for a 2nd correct simplified equation **M1** for correctly eliminating one variable for *their* equations in a and b **A1** for $a = \dfrac{1}{2}$ nfww **A1** for $b = \dfrac{3}{2}$ nfww

	(d)	**(i)**	171	2FT	**FT** *their* $a \times 17^2 +$ *their* $b \times 17 + 1$ **M1** for *their* $a \times 17^2 +$ *their* $b \times 17 + 1$
		(ii)	673	1FT	**FT** *their* (d)(i) $\times 4 - 11$

1	(a)	(i)	60 and 45	2	**M1** for $105 \div (4+3)$
		(ii)	117.6[0] final answer	2	**M1** for 105×1.12 oe
		(iii)	125	3	**M2** for $105 \div (1 - \dfrac{16}{100})$ oe or **M1** for 105 seen associated with 84%
	(b)		30.68 final answer	6	**B5** for 30.7[0] or 30.68… or **B4** for 905 to 906 **and** 875 or 405 to 406… **and** 375 **OR** **M1** for $500 \times \left(1 + \dfrac{2}{100}\right)^{30} [-500]$ oe **M1** for $[500 +] \dfrac{500 \times 2.5 \times 30}{100}$ **B1** for 905 to 906 or 875 or 405 to 406 or 375
	(c)		480 or 479.8 to 479.9…	3	**M2** for $1469 \div \left(1 + \dfrac{3.8}{100}\right)^{30}$ oe or **M1** for $P \times \left(1 + \dfrac{3.8}{100}\right)^{30} = 1469$ oe
	(d)		6.5[0] or 6.500…	3	**M2** for $\sqrt[11]{\dfrac{120150}{60100}} [\times 100 - 100]$ oe or **M1** for $60100 \times (\ )^n = 120150$ oe where $n = 5$ or 11 or 55

1	(a)	(i)	11 054.25 final answer	2	**M1** for $18000 \times \left(1 - \dfrac{15}{100}\right)^3$ oe
		(ii)	16 500	3	**M2** for $14025 \div \left(1 - \dfrac{15}{100}\right)$ oe or **M1** for recognition of 14 025 as 85% soi
	(b)		260 final answer	2	**M1** for $P\left(1 + \dfrac{5}{100}\right)^2 = 286.65$ oe
	(c)	(i)	6.18	3	**M2** for $\dfrac{224.72 - 200}{200 \times 2} \times 100$ oe or $\dfrac{1}{2}\left(\dfrac{224.72}{200} \times 100 - 100\right)$ or **M1** for $\dfrac{200 \times r \times 2}{100}$ oe or $\dfrac{224.72 - 200}{200 \times 2}$ or $\dfrac{224.72}{200} \times 100 - 100$ soi by 12.36 If zero scored, **SC1** for 56.18 or 56.2 as final answer
		(ii)	6	3	**M2** for $\sqrt{\dfrac{224.72}{200}}$ or $\sqrt{\dfrac{224.72}{2}}$ soi by 1.06 or 106 or 10.6 or **M1** for $200\left(1 + \dfrac{r}{100}\right)^2 = 224.72$ oe

1	(a)	(i)	1050	2	**M1** for $924 \div 22$ oe or $924 \div 0.88$ oe If zero scored, **SC1** for 126 seen
		(ii)	12	1	
		(iii)	5 ¼ hrs or 5.25 hrs	2	**M1** for $9 \div (7 + 5)$ or $540 \div (7 + 5)$ If zero scored, **SC1** for answer 3.75h or 3h 45 mins
	(b)		24.6[0]	3	**M2** for $15.99 \div \left(1 - \dfrac{35}{100}\right)$ oe or **M1** for 65% associated with 15.99
	(c)		63	3	**M2** for $35 \times \sqrt{\dfrac{2835}{875}}$ oe or **M1** for $\sqrt{\dfrac{2835}{875}}$ or $\sqrt{\dfrac{875}{2835}}$ or better or $\dfrac{\sqrt{2835}}{?} = \dfrac{\sqrt{875}}{35}$ oe **OR** **M2** for $\sqrt{2835 \times \dfrac{35}{their(875 \div 35)}}$ oe or **M1** for $\dfrac{35}{their(875 \div 35)}$ or $\dfrac{their(875 \div 35)}{35}$
	(d)	(i)	0.661[0]	1	
		(ii)	48	3	**M2** for $\dfrac{18.50 - 12.50}{12.50} \times 100$ or **M1** for $\dfrac{18.50 - 12.50}{12.50}$ or $\dfrac{18.50}{12.50} \times 100$

10	(a)	A:	14	$3n - 1$ oe	3	**B1** for 14 **B2** for $3n - 1$ oe or **M1** for $3n + k$, for any k oe
		B:	–4	$26 - 6n$ oe	3	**B1** for –4 **B2** for $26 - 6n$ oe or **M1** for $k - 6n$, for any k oe
		C:	25	n^2 oe	2	**B1** for 25 **B1** for n^2 oe
		D:	20	$n^2 - n$ oe	2	**B1** for 20 **B1** for $n^2 - n$ oe
	(b) (i)	$\dfrac{n(3n+1)}{2} = 155$			M1	Accept $\dfrac{3n^2 + n}{2} = 155$
		$3n^2 + n = 310$				Intermediate step must include elimination of fraction eg $n(3n + 1) = 310$
		$3n^2 + n - 310 = 0$			A1	With no errors or omissions
	(ii)	10 , $-\dfrac{31}{3}$ oe			3	**M2** for $(3n + 31)(n - 10)$ [= 0] or **M1** for $3n(n - 10) + 31(n - 10)$ or $n(3n + 31) - 10(3n + 31)$ or $(3n + a)(n + b)$ where $ab = -310$ or $a + 3b = 1$
	(iii)	10			1FT	**FT** *their* **b(ii)** if only one positive integer solution