3.7 Spreadsheet Tasks

- When you have the opportunity to use a spreadsheet program, there are many good tasks you can do (see sheets). Some explanation of how a spreadsheet works may be needed, depending on pupils' previous experience, but the sheets are intended for pupils to work through relatively independently (e.g., in pairs) at their own speed.
- Pupils will need to know to use ***** for multiplication and **/** for division, and where to find them on the keyboard. The other necessary skill to teach at the beginning is how to copy a formula "down a column". (You could demonstrate how to put the numbers 1 to 20 into column A in just a few seconds.)

3.7.1 1. Think of a Number.
A fairly easy task to begin.

Answer:
The overall effect is to add 10.
$$\tfrac{1}{4}(2(2(x+17)-4)-20)$$
$$=\tfrac{1}{4}(2(2x+30)-20)$$
$$=\tfrac{1}{4}(4x+40)=x+10$$

3.7.2 2. How Old Are You?

Some pupils may expect the number to change every second (since a computer is a "live" thing and it ought to know that we're all getting older all the time), but the computer doesn't "know" that its sums have got anything to do with time.

Answer:
A thirteen-year-old (for example) should be about 4 × 10⁸ seconds old.
10 years = 3 × 10⁸
100 years = 3 × 10⁹

You may need to show pupils how to widen the columns so that the numbers display properly. Standard form notation (with an E*) can be confusing.*

3.7.3 3. Magic Squares.
e.g.,

2	9	4
7	5	3
6	1	8

Answer:
There are many, but a 5 in the middle and even numbers in the corners will help. That way you can use all the integers from 1 to 9 once each and get a magic total of 15.

3.7.4 4. Sequences.
"Winning" means getting bigger faster.

Answer:
Higher powers will win!

3.7.5 5. More Sequences.

The nth term is given by the expression $\tfrac{1}{3}(a+2b)+\tfrac{4}{3}(b-a)(-\tfrac{1}{2})^{n}$, and as $n \to \infty$, this expression $\to \tfrac{1}{3}(a+2b)$.
With $a=7$ and $b=3$, the nth term becomes $\tfrac{13}{3}-\tfrac{16}{3}(-\tfrac{1}{2})^{n}$, which $\to 4\tfrac{1}{3}$ as $n \to \infty$.

Answer:
If a is the first number and b is the second, then the sequence gets closer and closer to $\tfrac{1}{3}a+\tfrac{2}{3}b$, so for 7 and 3 you should get $4\tfrac{1}{3}$.
Using 3 and 7 (the same starting numbers, but in the opposite starting order) gives $5\tfrac{2}{3}$.

3.7.6 6. Boxes.
A Fibonacci-type *(1170-1250)* investigation.

This idea also appears in section 3.6.18.

Answer:
Pairs of starting values that work are (2, 24); (7,21); (12,18); (17,15); (22,12); (27,9); (32,6) and (37,3). Algebraically we want solutions to $3x+5y=126$ where x and y are positive integers.

3.7.7 7. Credit Card Numbers.

Answers:
a yes; b yes; c yes; d yes; e no.

3.7.8	8. Even More Sequences.							

3.7.8   8. Even More Sequences.

Answer:
If the first term is a and you divide by n each time,

the sum gets closer and closer to $\dfrac{an}{n-1}$.

So starting with 1 and dividing by 2 each time gives an infinite sum of 2.
Starting with 1 and dividing by 3 each time gives an infinite sum of 1.5

3.7.9   9. A Rich Aunt

Answer: (See the solution below.)

Which one you'd choose depends on how long you expect your Aunt to live (or whether she might change her mind before she dies!) and on how quickly you need the money!

3.7.10   10. Cubic Graphs.

This is a task that you could do much more easily using graph-plotting software (see section 1.24.3). One advantage of this approach is to give some insight into how such programs actually work.

Answers:
There are three basic types of cubic graph (plus their reflections in the y -axis):

- *like $y = x^3$, no peaks/troughs, gradient zero at the origin;*
- *like $y = x^3 + x$, no peaks/troughs, gradient positive at the origin;*
- *like $y = x^3 - x$, 1 peak and 1 trough, gradient negative at the origin.*

$y = 2^x$ grows the fastest for large enough x .

Rich Aunt Solution (Task 9)

years	plan A	plan A total	plan B	plan B total	plan C	plan C total	plan D	plan D total
1	100	**100**	10	**10**	10.00	**10.00**	1	**1**
2	90	**190**	20	**30**	15.00	**25.00**	2	**3**
3	80	**270**	30	**60**	22.50	**47.50**	4	**7**
4	70	**340**	40	**100**	33.75	**81.25**	8	**15**
5	60	**400**	50	**150**	50.63	**131.88**	16	**31**
6	50	**450**	60	**210**	75.94	**207.81**	32	**63**
7	40	**490**	70	**280**	113.91	**321.72**	64	**127**
8	30	**520**	80	**360**	170.86	**492.58**	128	**255**
9	20	**540**	90	**450**	256.29	**748.87**	256	**511**
10	10	**550**	100	**550**	384.43	**1133.30**	512	**1023**
11	0	**550**	110	**660**	576.65	**1709.95**	1024	**2047**
12	−10	**540**	120	**780**	864.98	**2574.93**	2048	**4095**
13	−20	**520**	130	**910**	1297.46	**3872.39**	4096	**8191**
14	−30	**490**	140	**1050**	1946.20	**5818.59**	8192	**16383**
15	−40	**450**	150	**1200**	2919.29	**8737.88**	16384	**32767**
16	−50	**400**	160	**1360**	4378.94	**13116.82**	32768	**65535**
17	−60	**340**	170	**1530**	6568.41	**19685.23**	65536	**131071**
18	−70	**270**	180	**1710**	9852.61	**29537.84**	131072	**262143**
19	−80	**190**	190	**1900**	14778.92	**44316.76**	262144	**524287**
20	−90	**100**	200	**2100**	22168.38	**66485.13**	524288	**1048575**

1 Think of a Number

	A	B
1	Think of a Number Investigation	
2		
3	Starting number	
4	Add 17	
5	Double it	
6	Subtract 4	
7	Double it again	
8	Subtract 20	
9	Divide by 4	
10		
11		
12		
13		
14		
15		

- Start a new spreadsheet.
- Copy this writing into the spreadsheet.
- Think of a number and put it in cell B3. This is the starting number.
- Type the formula **=B3+17** into cell B4. This will work out the new number.
- Put the right formulas into cells B5-B9.
- Look at the number in cell B9. Compare it with the starting number.
- Change the starting number and see what happens to the number in B9. Write down what you notice.

Questions

Can you explain what is happening?
Try changing the formulas. What will happen to the number in B9?

2 How Old Are You?

	A	B
1	How Old Are You?	
2		
3	In years	
4	In weeks	
5	In days	
6	In hours	
7	In minutes	
8	In seconds	
9		
10		
11		

- Start a new spreadsheet. We are going to use a spreadsheet to work out how old you are – in seconds!
- Copy this writing into the spreadsheet.
- Put your age (in years) into cell B3.
- Type the formula **=B3*52** into cell B4. This will work out how many weeks you have been alive.
- Put the right formulas into cells B5-B8.
- Write down how many seconds you have been alive.

Questions

Use the spreadsheet to answer these questions.
How many seconds is 10 years?
How many more seconds do you think you will live?
How many seconds are there in a century?

3 Magic Squares

	A	B	C	D
1	Magic Squares			
2				
3	1	5	2	
4	6	3	4	
5	8	7	9	
6				
7				

- Start a new spreadsheet.
  We are going to use a spreadsheet to make some *magic squares*.
  In a *magic square* the numbers in every row add up to the same total. The numbers in every column also add up to the same total, and the diagonal numbers also add up to the same total.

- Copy these numbers into the spreadsheet. This is **not** a magic square.
- Type the formula **=A5+B4+C3** into cell D2.
  This will work out the total for the 8,3,2 diagonal.
- Put a formula into cell D3 that will add up A3, B3 and C3 (the top row).
- Put formulas into D4 and D5 to add up the second and third rows.
- Put formulas into A6, B6 and C6 to add up the columns.
- Put a formula into D6 to add up the 1,3,9 diagonal.
  Now you can see all the totals around the edge of the number square.

Questions

How can you tell that this is not a magic square?
Change some of the numbers in the square. (Don't alter the formulas.)
The totals will change around the sides.
Can you make it into a magic square? *[Hint: Try making all the totals 15]*

4 Sequences

	A	B	
1	Sequences		
2			
3	Counting	Triangle	
4	1	1	
5			
6			
7			
8			

- Start a new spreadsheet.
  We are going to use a spreadsheet to work out some *sequences*.
- In maths, a *sequence* is a list of numbers that follow a rule. The simplest one is the counting numbers: 1, 2, 3, 4, 5, and so on.
- Copy this writing into the spreadsheet.
- Put the formula **=A4+1** into cell A5.

- Copy this down to cell A23, so that you have the first 20 counting numbers.
  [You need to "click-and-drag": you may need to ask for help doing this.]
- In column B we are going to put a sequence of numbers called the *triangle numbers*.
  They are the "running total" of the counting numbers.
- In cell B5 put the formula **=B4+A5**.
- Copy this down to cell B23.
  These are the *triangle numbers*. Do you know why they are called triangle numbers?
  The sequence of *square numbers* have challenged the triangle numbers to a race!
  Square numbers are 1*1=1 and 2*2=4 and 3*3=9 and so on.
- Use the spreadsheet to put the first 20 square numbers (starting with 1) in column C.
  Do they beat the triangle numbers?
  Add an extra column for the *cube numbers* (powers of 3).
  They are 1*1*1=1 and 2*2*2=8 and 3*3*3=27 and so on.
  Which sequence of numbers wins?
  What do you think will happen if the powers of 4 and powers of 5 join in?
  Who will win now?

5 More Sequences

	A	B	C
1	More Sequences		
2			
3	1	7	
4	2	3	
5	3		
6	4		
7	5		
8	6		
9	7		
10	8		
11	9		
	10		

- Start a new spreadsheet.
  We are going to try a more complicated sequence this time.
- Copy this writing into the spreadsheet.
- Make the counting numbers go down to cell A23 again.
  Remember to use the quick way of doing this.
- Put the numbers 7 and 3 into column B.
  They are the starting numbers.
  The rule for this sequence is that the next number is the *mean* of the last two.

The spreadsheet will work out the mean using the **AVERAGE** command.
- Put the formula **=AVERAGE(B3:B4)** into cell B5.
  [Note that you must put a colon **:** between the addresses of the two cells.]
  The answer should be 5 because 5 is the mean of 7 and 3. [Mean = (7+3)/2]
- Copy this formula down to cell B23.
  What happens to the numbers in the sequence?
  Try changing the 7 and 3 to different numbers. Can you work out what is going on?
  What have the final numbers got to do with the first two numbers that you choose?

6 Boxes

Here is a puzzle. Use a spreadsheet to help you solve it.
Look at the numbers in these boxes.

3	5	8	13	21	34

Going from left to right, each number is the sum of the *two* previous numbers.
3 + 5 = 8 and 5 + 8 = 13 and so on.

Suppose the final number is 126.

					126

Find 2 starting numbers that will give 126 in the final box.
For example, 10 and 12 won't do. They would make 90 in the final box (34+56).

10	12	22	34	56	90

Find out how many different pairs of numbers will make 126 in the final box.

How to do it

Set up a column in a spreadsheet to do all the adding up for you.
Every time you type in two starting numbers it does all the calculations, and you can see if you get to 126 at the end.
Be systematic with the numbers you try. Make sure you find *all* the solutions.

7 Credit Card Numbers

Many credit card numbers are 16 digits long. But not just any 16-digit number is a valid credit card number. There are some rules about what makes a valid credit card number. One simple one is this rule.

Take the 16 digits and number them from 1 to 16 from left to right.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4	0	4	9	4	0	3	2	1	6	7	2	3	1	0	7

Double every other digit, starting with the first. Write these in underneath.

8		8		8		6		2		14		6		0	

Where you end up with a 2-digit answer (like 14), add together the two digits (1+4=5). Fill in all the other spaces with the original digits – you don't double these ones.

8	0	8	9	8	0	6	2	2	6	5	2	6	1	0	7

Add up the numbers you end up with. This one comes to 70.
A valid credit card number will always come to a multiple of 10 (10, 20, 30, etc.).

Design a spreadsheet to check if these numbers could be valid credit card numbers.

a	4	0	4	9	2	8	4	3	0	6	4	2	1	8	9	7
b	4	0	4	9	3	0	6	4	8	6	3	1	8	3	4	4
c	4	0	4	9	3	4	1	0	2	9	5	3	4	2	1	4
d	4	0	4	9	2	0	1	7	2	6	3	5	1	4	9	6
e	4	0	4	9	2	6	3	1	8	1	9	0	3	4	2	5

8 Even More Sequences!

This time you are going to use a spreadsheet to look at the sequence of numbers you get if you start with 1 and keep dividing by 2 each time to get the next number. It begins 1, 0.5, 0.25, …

- Put the first 20 terms into cells A1 to A20.
  [You need to put **1** into cell A1. Cell A2 will be **=A1/2** and then copy this formula down to A20.]
- Put a running total in cells B1 to B2.
  [Cell B1 will be **=A1**, B2 will be **=B1+A2**, and then copy this formula down to B20.]
  What number does the total of the sequence get closer and closer to?
  (Look at the numbers in B18, B19 and B20.)

- Try putting the number 12 into A1 instead of 1.
  What is the new total for the sequence?
  Try some other numbers in A1. What is the connection?

- What if you go back to starting with 1 but this time divide by *3* each time?
  Can you write the rule in algebra – if you started with a and divided by n each time what would the total be in algebra?

  Extra Task:
  Select cells A1-A20 and B1-B20 and click on the graph icon at the top.
  Choose line graph and put the graph into your spreadsheet.

9 A Rich Aunt

Your rich aunt sends you this letter:

> Now that I'm getting on in years (I'm 70 today), I want to give you some of my money.
> You can choose whether to have
>
> A   £100 now, £90 next year, £80 the year after that, and so on;
> B   £10 now, £20 next year, £30 the year after that, and so on;
> C   £10 now, 1½ times as much next year, 1½ times as much as that the year after, and so on;
> D   £1 now, £2 next year, £4 the year after, £8 the year after that, and so on.
>
> Of course, the scheme will only run while I am alive!

Design a spreadsheet to work out how much money you would earn from each scheme in
- **1** 5 years
- **2** 10 years
- **3** 15 years

Which one would you choose?

10 Cubic Graphs

Cubic graphs are graphs of equations that contain an x^3 term (x to the power of 3).
In a spreadsheet the "to the power of" symbol is **^**.

You are going to use a spreadsheet to calculate some values of functions involving x^3, and then use the graph feature to draw the graphs.

First we want some values of x^3, so we'll vary x between –2 and 2 and work out x^3 for each.
- In column A we want the x numbers from –2 to 2 going up in 0.2's.
  In cell A1 we need **–2** and in cell A2 **=A1+0.2**.
  Copy this formula down column A until you get to 2 (up to cell A21 if you start in A1).
- In column B we want the x^3 numbers. So in cell B1 the formula will be **=A1^3**. Copy this down column B (to cell B21).
- Now if you select columns A and B and click on the graph icon, you can see what the graph of $y = x^3$ looks like. Choose the scatter-graph option.
  Describe the shape of the graph.

Now try drawing some of these graphs.
How are they different from each other? How are they similar?
Where (at what value(s) of x) do they cross the x axis (horizontal one)?

$$y = -x^3 \qquad\qquad y = x^3 + x \qquad\qquad y = x^3 - x \qquad\qquad y = 2x^3 \qquad\qquad y = x^3 + 2$$

[You will need to use formulas like **=–A1^3** and **=A1^3+A1** and **=2*A1^3**.]

Extra Task:
Plot these graphs (below) for x between –5 and 5 and describe the ways in which they are different.
Although they all contain an x and a 2, they do not look alike.

$$y = x + 2 \qquad\qquad y = 2x \qquad\qquad y = x^2 \qquad\qquad y = 2^x$$

Which one grows the fastest as x increases?