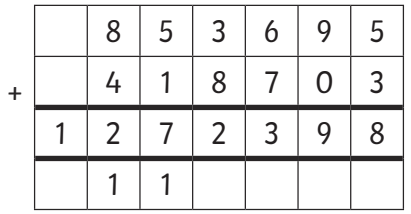
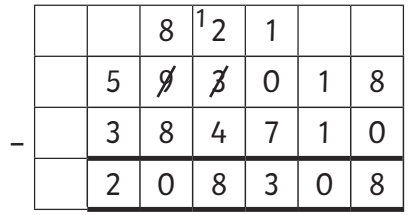
Improve the Approximations

In some of these approximations, there are errors and in some, you can easily create closer approximations. Your job is to figure out what the numbers have been rounded to in the approximations, spot all the errors and improve the approximations to make them as close as possible. Then, work out the actual answer and see how close your improved approximation is. One example has been done for you.

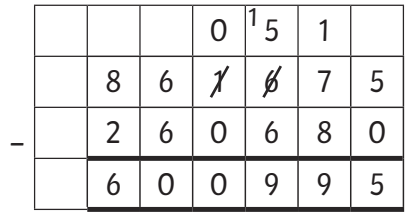
Calculation:	First Approximation:	Improved Approximation:	Actual Answer:
853 695 + 418 703 = ?	850 000 + 410 000 = 1 260 000 **Error in approximation**	850 000 + 420 000 = 1 270 000	
593 018 − 384 710 = ?	600 000 + 400 000 = 200 000 **Not close approximation**	590 000 − 380 000 = 210 000 or 593 000 − 385 000 = 208 000	
861 675 − 260 680 = ?	862 000 + 260 000 = 602 000 **Error in approximation**	862 000 − 261 000 = 601 000	
104 723 + 649 916 = ?	100 000 + 600 000 = 700 000 **Not close approximation**	105 000 + 650 000 = 755 000 or 100 000 + 650 000 = 750 000	



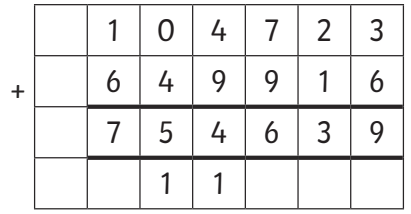
	8	5	3	6	9	5
+	4	1	8	7	0	3
1	2	7	2	3	9	8
	1	1				



		8	$^{1}2$	1		
	5	~~9~~	~~3~~	0	1	8
−	3	8	4	7	1	0
	2	0	8	3	0	8



			0	$^{1}5$	1	
	8	6	~~1~~	~~0~~	7	5
−	2	6	0	6	8	0
	6	0	0	9	9	5



	1	0	4	7	2	3
+	6	4	9	9	1	6
	7	5	4	6	3	9
		1	1			

Improve the Approximations

In some of these approximations, there are errors and in some, you can easily create closer approximations. Your job is to figure out what the numbers have been rounded to in the approximations, spot all the errors and improve the approximations to make them as close as possible. Then, work out the actual answer and see how close your improved approximation is. One example has been done for you.

Calculation:	First Approximation:	Improved Approximation:	Actual Answer:
853 695 + 418 703 = ?	850 000 + 410 000 = 1 260 000 **Error in approximation**	850 000 + 420 000 = 1 270 000	
593 018 – 384 710 = ?	600 000 + 400 000 = 200 000		
861 675 – 260 680 = ?	862 000 + 260 000 = 602 000		
104 723 + 649 916 = ?	100 000 + 600 000 = 700 000		

		8	5	3	6	9	5
+		4	1	8	7	0	3
	1	2	7	2	3	9	8
		1	1				

–							

–							

+							

Travelling Cards

Paulo and Anya are on holiday in Indonesia for 3 days. In Indonesia, the currency is in rupiah.

1

Anya brings £40 spending money on their trip and Paulo brings £45. At the airport, they get their money converted into rupiahs. Anya receives 806 281 rupiahs and Paulo receives 907 066 rupiahs. How many rupiahs do they have to spend in total?

Paulo spends 160 301 rupiah on food over three days and Anya spends 220 413 rapiah over three days. How many rupiahs have they spent on food altogether?

They buy presents for Paulo's sister and Anya's dad. Anya buys a carved Indonsesian box for her dad costing 120 226 rupiahs and Paulo buys a beaded gem bracelet costing 169 146 rupiahs. How much did they spend on their gifts altogether?

2

Anya and Paulo have a budget of 467 000 rupiahs for travel for the three days. They spend 114 400 rupiahs on the first day. How much do they have left for days two and three?

They found a boat trip that cost 947 381 rupiahs but then decided to go on one that was 423 298 rupiahs cheaper. How much was it?

When they return to the airport, they have 52 178 rupiahs of their original spending money left. How many rupiahs have they spent on their trip? (Use the answer you got from card 1 to help you.)

Adult:	Pupil/s:	Date:

Key Questions for Deepening Understanding	Comments
• What would be the first thing you would do when given this addition? Why? • Is there anything we can do to roughly see what the answer is before calculating it? • What does the word estimation mean? • Does anyone know the word approximation? What does it mean? (approximation means that you perform a 'close' calculation) • Why is it useful to have an approximate answer? • What would you do first to find an approximate answer for this calculation? • What could we round 361 047 and 620 865 to? • Would it be best to round to the nearest 1000, 10 000 or 100 000? Why? • Which would give us the closest approximate answer? Why? • Now, can you use column addition to complete this calculation? • How do the approximations compare to the actual answer? • Which approximation was the most helpful? Why? • How should we round numbers to get the most helpful approximation? • If the approximate answer and the actual answer are close, what does this tell us about our working out? • How do the approximations compare to the actual answer? • Which approximation was the most helpful? Why? • How should we round numbers to get the most helpful approximation?	

Adult:	Pupil/s:	Date:

Key Questions for Deepening Understanding	Comments
• If the approximate answer and the actual answer are close, what does this tell us about our working out? • What calculation is required to answer the question on your card? • What calculation is required to answer the question on the card the other team were given? • How did they round the numbers in the addition calculation or subtraction calculation? • What was their approximate answer? Was it easy enough to use mental methods? • How close was the approximate answer to the actual answer? What does this tell us?	

Additional Notes

Same-Day Intervention: **Rounding to Estimate and Approximate**

Children will learn how to use and apply their rounding knowledge to estimate answers to calculations.

Pre-Intervention Check

To access this intervention, can the children... *Tick as appropriate.

...round numbers with up to six digits to the nearest 1000, 10 000 and 100 000?*

...mentally add and subtract multiples of 1000 with up to six digits?*

Explaining the Gap in Mathematical Understanding

When children are using column methods to solve a calculation, they should be taught to approximate the answer first to ensure that they can quickly identify if they have made an error and given an unreasonable answer. In year 5, children start to use the language of approximating rather than estimating and should be supported in deciding how best to round numbers to ensure they can approximate a calculation effectively. If the children are not selecting the most appropriate number to round to, they could end up with an approximation that will not be helpful in identifying errors in their working out.

For example, when calculating 24 585 + 51 038, a child may make an approximation using 20 000 + 50 000, when a more sensible approximation would be 25 000 + 51 000.

Children should explore rounding in everyday contexts to help address this. Approximating answers is a key step when using written methods and children should be able to quickly and confidently do this to identify arithmetic errors.

Preparation

- Whiteboards and pens
- **Travelling cards** (1 per pair)
- **Improve the approximations** (1 per child)
- **Improve the approximations answers**

Key Vocabulary

- Reasonable answer, close answer
- Estimation, approximation, approximate answer
- Round to the nearest 1000, 10 000 or 100 000
- Actual answer

Addressing the Gap

Children will begin by looking at an addition calculation and think about approximations that they could make. They will then round the numbers in the calculation to the nearest 1000, 10 000 and 100 000 to see which one allows for mental addition while giving a close approximation. Then, children will solve the addition using the written method and compare their answer to their approximation. This is repeated, using a subtraction calculation. The children will then split into two teams and will be introduced to addition and subtraction questions in real-life contexts. Both teams round the numbers to find an approximate answer and then calculate the answer to these questions using written methods. Afterwards, the other team will check the work and award a point for each stage: the rounding, approximation and actual answer. This is then continued in a game in pairs.

Key Questions for Deepening Understanding (Continued)

On the board, write 361 047 + 620 865.

- What would be the first thing you would do when given this addition? Why?
- Is there anything we can do to roughly see what the answer is before calculating it?
- What does the word estimation mean?
- Does anyone know the word approximation? What does it mean? (approximation means that you perform a 'close' calculation)
- Why is it useful to have an approximate answer?
- What would you do first to find an approximate answer for this calculation?
- What could we round 361 047 and 620 865 to?
- Would it be best to round to the nearest 1000, 10 000 or 100 000? Why?
- Which would give us the closest approximate answer? Why?

In three separate groups, children round 361 047 and 620 865 to the nearest 1000, 10 000 and 100 000 and **mentally** calculate the approximate answers (as shown). They write their approximation on a whiteboard.

Rounded to the Nearest 1000	Rounded to the Nearest 10 000	Rounded to the Nearest 100 000
361 000 + 621 000 = 982 000	360 000 + 620 000 = 980 000	400 000 + 600 000 = 1 000 000

- Now, can you use column addition to complete this calculation?

Children carry out the addition on their whiteboards (as shown).

	3	6	1	0	4	7
+	6	2	0	8	6	5
	9	8	1	9	1	2
				1	1	

- How do the approximations compare to the actual answer?
- Which approximation was the most helpful? Why?
- How should we round numbers to get the most helpful approximation?
- If the approximate answer and the actual answer are close, what does this tell us about our working out?

On the board, write 915 627 – 493 340. Repeat questions from the previous section and have all children round the numbers to whichever they find the most helpful (nearest 1000, 10 000 or 100 000) and calculate using mental methods (as shown).

Rounded to the Nearest 1000	Rounded to the Nearest 10 000	Rounded to the Nearest 100 000
916 000 - 493 000 = 423 000	920 000 - 490 000 = 430 000	900 000 - 500 000 = 400 000

Children carry out the subtraction on their individual whiteboards (as shown).

	$^{8}\not{9}$	$^{1}1$	5	$^{5}\not{6}$	$^{1}2$	7
–	4	9	3	3	4	0
	4	2	2	2	8	7

- How do the approximations compare to the actual answer?
- Which approximation was the most helpful? Why?
- How should we round numbers to get the most helpful approximation?
- If the approximate answer and the actual answer are close, what does this tell us about our working out?

Split the group into two teams. Give one team card 1 and the other team card 2 from the **travelling cards** and read out the introduction.

- What calculation is required to answer the question on your card?

Children round the numbers to the nearest 1000, 10 000 or 100 000, agreeing with their team on which would be the most helpful. Then, they use mental methods to complete their approximate answer. After, children complete the calculation, using written methods, on one of their whiteboards.

Key Questions for Deepening Understanding (Continued)

Teams then swap their whiteboards and travelling cards with the other group so they can review each other's work, checking rounding and calculation.

- **What calculation is required to answer the question on the card the other team were given?**
- **How did they round the numbers in the addition calculation or subtraction calculation?**
- **What was their approximate answer? Was it easy enough to use mental methods?**
- **How close was the approximate answer to the actual answer? What does this tell us?**

The teams give feedback to each other about whether the rounding was sensible, whether their approximation was close to the actual answer and whether their calculation was correct or not. Then, they swap cards so both teams have a go at completing both questions.

Put the children into pairs. Lay out the rest of the **travelling cards**, facing up. Both children in the pair take a different card and, on their whiteboards, round the numbers sensibly to find an approximate answer using mental calculation. Then, children calculate the actual answer using column addition or subtraction. Once they have finished, they give their card and whiteboard to their partner who then checks through their rounding, approximate answer and written calculation. They award a point for each one: one point for sensible rounding (to the nearest 1000, 10 000 or 100 000), one point for correctly calculated and close approximate answer (using mental methods) and one point for a correct actual answer. Each child should keep a tally of their points on their whiteboard. The person with the most points after all the cards have been solved is the winner.

Additional Opportunities to Reinforce Learning

Using the **improve the approximations** resource, children work individually to spot any the errors made in the approximations and improve them so they are more accurate. Some of these approximations contain errors and in some, children can easily create closer approximations.

Then, children work out the actual answer using written methods and see how close their improved approximation is.

Use the **improve the approximations answers** to help you.

Home Learning Slip

Today, at school, your child has been using approximations to check their working out. This means they have been rounding the numbers in a calculation to the nearest 1000, 10 000 or 100 000 and then adding or subtracting them (depending on the question) using mental methods. They have been comparing these approximations to their answers from the written column method to see if they are reasonable. To support their learning, you could play this game with them. Each of you roll a dice six times to create two six-digit numbers. Decide together whether you want to add the numbers or subtract one from the other. Then, separately, round the numbers to find an approximate answer using mental methods and write it down. Following this, calculate the answer using column addition or subtraction. Once you have both finished, give your working out to each other to compare. Have you both rounded the numbers in the same way? Have you got the same approximation? Which is closer? Have you got the same answer from the written method? Award a point for the closest approximation to the actual answer. Repeat by generating further six-digit numbers.

For example: 462 016 + 265 634 = ?

Rounded to the nearest 10 000:

460 000 + 270 000 = 730 000 (approximate answer)

	4	6	2	0	1	6
+	2	6	5	6	3	4
	7	2	7	6	5	0
	1				1	

(actual answer)

Thank you for your support with this. Your help will really make a difference to your child.

Home Learning Slip

Today, at school, your child has been using approximations to check their working out. This means they have been rounding the numbers in a calculation to the nearest 1000, 10 000 or 100 000 and then adding or subtracting them (depending on the question) using mental methods. They have been comparing these approximations to their answers from the written column method to see if they are reasonable. To support their learning, you could play this game with them. Each of you roll a dice six times to create two six-digit numbers. Decide together whether you want to add the numbers or subtract one from the other. Then, separately, round the numbers to find an approximate answer using mental methods and write it down. Following this, calculate the answer using column addition or subtraction. Once you have both finished, give your working out to each other to compare. Have you both rounded the numbers in the same way? Have you got the same approximation? Which is closer? Have you got the same answer from the written method? Award a point for the closest approximation to the actual answer. Repeat by generating further six-digit numbers.

For example: 462 016 + 265 634 = ?

Rounded to the nearest 10 000:

460 000 + 270 000 = 730 000 (approximate answer)

	4	6	2	0	1	6
+	2	6	5	6	3	4
	7	2	7	6	5	0
	1				1	

(actual answer)

Thank you for your support with this. Your help will really make a difference to your child.