Y7 UNIT 16 *Algebra: Linear Equations* Lesson Plan 1

Basic Algebra 1

Activity		*Notes*
1A	**Introduction to coding** T: Today we're going to code and decode letters and numbers. **OS 16.1** T: What can you see on the OHP? *(A circle with letters in it)* T: How is it divided up? *(There are sections and rings in it)* T: Yes, there are two circles with letters in them. Point to the outer one; what can you say about the letters in it? *(The letters of the alphabet, in alphabetical order)* T: And what about the letters in the inner circle? *(The same letters, but starting in a different position)* T: One of the circles codes the letters of the other one. What do we mean by 'coding'? *(Other letters are substituted for the real ones)* T: Say aloud some of the pairs you can see here. *(A-Y, B-Z, C-A, ...)* T: In the message shown here, which circle codes the other one?	Whole class activity. T puts the code wheel on OHP and lets Ps find out how it works. T can help them by asking questions.

HSKN	HSKN
↓	↓
FQIL	JUMP

HSKN	(outer circle)	HSKN	(inner circle)
↓		↓	
FQIL	(inner circle)	JUMP	(outer circle)
⇓		⇓	
is not intelligible		the inner circle codes the outer one	

T calls out two volunteer Ps; one for the inner circle and the other to use the outer circle as a decoder.

Agreement. Praising.

T: Now, let's decode the messages.

Ps at BB:

HSKN	ML	Y	ZSQ
↓	↓	↓	↓
JUMP	ON	A	BUS
EM	DMP	EMJB	
↓	↓	↓	
GO	FOR	GOLD	

T writes the code words on BB and calls 6 Ps out to decode them (first one has already been done). Slower Ps may need help.
Agreement. Praising.

1B	**Individual work using the code wheel** T: Now try this one on your own. I know it will be difficult for you to admit that it's true! I LOVE MATHS *(G JMTC KYRFQ)* T: So how do you write the name of this lesson using the code wheel? Ps: KYRFQ.	Individual work. Ps open Ex.Bs at p52 and use the code wheel on it. T monitors Ps' work and may help slower Ps to code the first few letters. Checking: a volunteer P writes the sentence on BB: others agree or correct. Feedback, self-correction. Praising.

12 mins

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Activity		***Notes***
2	**Coding numbers** T: We can code numbers in a similar way, and also use tables for coding. For example, let's look at this code table: k 5 l 4 m –3 n 8 T: I'll give you some statements, and you can decode them using the table on the OHP. Say whether each one is true or false. - Each square has l sides of the same length *($l = 4$, true)* - There are exactly k pupils in this class *($k = 5$, probably false)* - A regular polygon with n sides is called an octagon *($n = 8$, true)* - You have m maths lessons each week *($m = -3$, false)* T: What about $l + n$? Make up a question which has the answer $l + n$. *(e.g. What is the total number of sides of a square and an octagon?)* T: And the answer? *($l + n = 4 + 8 = 12$)* T: Now do these calculations: $m + 2 =$ *($-3 + 2 = -1$)* $k - 10 =$ *($5 - 10 = -5$)* $l - m =$ *($4 - (-3) = 4 + 3 = 7$)*	Whole class activity. T asks different questions to practice using letters instead of numbers. The code table and statements are shown on OHP. T calls Ps to BB to substitute (decode) letters for numbers, and then do the addition or subtraction. Agreement. Praising. Ps write calculations and answers in Ex.Bs. Verbal checking. Agreement. Praising.
	22 mins	
3	**Practice** **PB 16.1, Q4 (b)** 4, **(c)** 10 **PB 16.1, Q5 (a)** 4, **(b)** – 1	Individual work, monitored, helped) followed by detailed checking at BB. For Q5, T must draw attention to the correct substitution of the numbers *before* the calculation is attempted, so avoiding the misconception $a - b = 3 - 1$ (correct substitution is $a = 3$, $b = -1$). Agreement, feedback, self-correction. Praising.
	28 mins	

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Activity		***Notes***
4	T: Let's look at something different now. We'll use the letters *a*, *b* and *d* to represent the cost of some fruits. T: Writes on BB: *a*: the cost of one kilogram of apples *b*: the cost of one kilogram of bananas *d*: the cost of a box of dates. Now work out the answers to these questions. - How much do I pay for 3 kg of apples? $(a \times 3 = 3 \times a = 3a)$ - How much do I pay for 2 boxes of dates? $(d \times 2 = 2d)$ - What will be the total cost of 2 kg of apples and 5 kg of bananas? $(2a + 5b)$ - How much will *n* kg of bananas cost? $(b \times n = nb)$ T: What will your answers be if: $a = 50$ pence $b = 60$ pence $d = 40$ pence $n = 4$ Ps (at BB): $3a = 3 \times 50\text{p} = 150\text{p} = £1.50$ $2d = 2 \times 40\text{p} = 80\text{p}$ $2a + 5b = 2 \times 50\text{p} + 5 \times 60\text{p} = 100\text{p} + 300\text{p} = £4.00$ $nb = 4 \times 60\text{p} = 240\text{p} = £2.40$	Whole class activity. Ps continue to practice using letters to represent numbers. T asks, volunteer Ps to come to BB and write their answers. Other Ps agree (or not) and write the calculations in their Ex.Bs. Praising. Now other Ps come to BB to evaluate the expressions. Agreement. Praising.
	38 mins	
5	**PB 16.1, Q4 (e)** 8, **(f)** 6, **(i)** 24 **PB 16.1, Q5 (i)** 13, **(j)** – 2	Individual work, monitored, helped. Detailed checking at BB. Feedback, self-correction. Praising.
	45 mins	
6	**Set homework** **PB 16.1, Q4 (a), (g), (k)** **PB 16.1, Q5 (c), (k), (l)** **PB 16.1, Q6 (a), (b)**	

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 2	*Basic Algebra 2*
Activity		***Notes***
1	**Checking homework** **PB 16.1, Q4** (a) 8 (g) 18 (k) 18 **PB 16.1, Q5** (c) –5 (k) 20 (l) 3 **PB 16.1, Q6** (a) 24 (b) 8 *5 mins*	T checks by asking Ps to give answers verbally. If many Ps have found this difficult, T asks a successful P to show the solution to the class. Self-correction. Praising.
2	**Warm-up practice** T: Some parts of the homework were quite difficult. Let's do some easy questions now to warm up. T: If $x = 3$, what is $2x$? *(6)* If $x = -2$, what is $4x$? *(–8)* If $y = 8$, what is $y + 3$? *(11)* If $z = 5$, what is $z - 6$? *(–1)* If $x = 2$, $y = 3$, what is $x + y$? *(5)* If $a = 7$, $b = 4$, what is $a - b$? *(3)* etc. For example, If $a = -4$, $b = -3$, what is $-2a + 3b$? *(–1)* **etc.** *12 mins*	Mental work. These questions are similar to the easy ones in the previous lesson. They are useful for helping slower Ps to manipulate with letters. Now more difficult questions to challenge stronger Ps who can do these mentally; other Ps can use their Ex.Bs.
3A	**Simplifying** T: Now we're going to move on to calculations involving decimals. If $a = 0.59$, calculate $2a + 7 - 5a + 3a$. $2 \times 0.59 + 7 - 5 \times 0.59 + 3 \times 0.59 = 7$ T: So the answer is 7. T: Let's break this down into parts. What does $2a$ mean? Ps: $a + a$ T: $3a$? Ps: $a + a + a$ T: $-5a$? Ps: $-a - a - a - a - a$ T: And what about the whole expression? P (writes on BB): $2a + 7 - 5a + 3a =$ $= a + a + 7 - a - a - a - a - a + a + a + a$ and that is 7.	Whole class activity. Here T should deliberately mislead Ps to emphasise the usefulness of simplifying. T calls 3 Ps to BB to calculate 2×0.59, 5×0.59 and 3×0.59 then a fourth P does the addition and subtraction. T should (mis)lead the Ps quickly, so that they don't have time to realise. Finally T lets Ps discover for themselves that the process of simplifying will make the task easier. Ps may answer in chorus. Having done Unit 15, Ps know that $= +(-) = -$, and can use one instead of the other.
(continued)		

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 2	*Basic Algebra 2*
Activity		***Notes***
3A *(continued)*	T: Why? $2a + 7 - 5a + 3a$ $= a + a + 7 + (-a) + (-a) + (-a) + (-a) + (-a) + a + a + a$ T: And what have we learnt about the parts of sums? P: That their numbers are interchangeable. T: So how can we use that here? P: We can write it in this form: $7 + 5 \times a + 5 \times (-a) = 7 + 5a - 5a = 7$ T: If we had realised this before, we could have saved a lot of time!	Now T leads Ps to recognise that the sum can be written like this. Agreement. Praising.
3B	**More practice with simplifying** T: Now see how you get on with simplifying these expressions. Show the processes that lead to your answers. (a) $4a + 2a$ (b) $4x - 3x$ (c) $3b + 1 + 2b$ (d) $4x + 2y - 2x + 3y$ (e) $3a + 4b$ P (e.g. at (a), writes on BB): $(a + a + a + a) + (a + a) = a \times 6 = 6a$ etc.	Whole class activity. T writes the expressions on BB and calls out volunteer P to explain and simplify. Agreement. Praising. Ps write in Ex.Bs. Discussion leads to realisation that (e) cannot be simplified.
3C	**Simplifying complicated expressions** T: Now calculate the following, given that $x = 2,\ y = 0.3497$. (a) $2x - 1 + 4y + 3x - 4y$ (b) $4x + y - 5x + x$ T: What do you think about y ? It's an easy number to work with, isn't it? Ps: No! T: What do you mean? I'm sure each one of you is hoping that I'll ask *you* to do this calculation! Ps: No! T: So what can we do to make it easier? Ps: First we should simplify the expressions. T: Who'd like to do the first one? *(... $= 5x - 1 = 5 \times 2 - 1 = 9$)* and the other? *(... $= y = 0.3497$)* *25 mins*	Whole class activity. Tasks appear on BB. T lets Ps protest, but goes on to give a clue to how it can be done. Volunteer Ps comes to BB to show the solutions. Agreement. Praising.
4 *(continued)*	**Individual practice** T: Evaluate the following expressions, but first think of the simplifications. (a) If $a = 2,\ b = 5,$ $2a + b - 4a + 5a = ?$ (b) If $x = 1,\ y = 2,$ $3x - y + 1 = ?$	Individual work, monitored, helped. Tasks appear on BB or OHP.

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 2	*Basic Algebra 2*
Activity		***Notes***
4 *(continued)*	(c) If $a = -4.231,\ b = -3,\quad 3a + 2 - 7a + 2b + 4a - b = ?$ *(Solutions* *(a)* $3a + b = 3 \times 2 + 5 = 11$ *(b)* $3x - y + 1 = 3 \times 1 - 2 + 1 = 2$ *(c)* $b + 2 = -3 + 2 = -1$*)* *32 mins*	Detailed checking at BB. Agreement, feedback, self-correction. Praising.
5A	**Examples of simplifying** T: We've worked with letters before, for example, when we were studying perimeters and areas. Let's look at this square and rectangle. T: How do we label their sides? P_1 (comes to BB, writes and gives explanation): We label each of the sides of a square '*a*', because they are all the same length. P_2: We label the sides of a rectangle '*a*' and *'b'*, because they are of two different lengths. T: What do we mean by the *perimeter* of a polygon? Ps: The total length of its sides. T: Well done. Now I'll write these on the BB: $p(\text{square}) = a + a + a + a$ $p(\text{rectangle}) = a + b + a + b$ What do we do to get the final forms of formulae? P: We simplify them. T: So what should I write now? Ps instruct: T writes on BB: $p(\text{square}) = a \times 4 = 4a$ $p(\text{rectangle}) = a \times 2 + b \times 2$ or $= (a + b) \times 2 = 2(a + b)$	T draws square and rectangle on BB. Agreement. Praising.
5B	**Simplifying formulae for perimeters of polygons** T: Now you're going to see some polygons with sides of different lengths. Work out a formula for the perimeters. **OS 16.3** *40 mins*	Whole class activity. Tasks appear on OHP. T calls Ps to read and write down perimeters and simplify the formulae wherever possible. T encourages slower Ps and also helps them. Agreement. Praising.
6	**Individual work** **PB 16.1, Q10 (b)** $2a + b$ **(d)** $6a$ **(f)** $4a + 4b$ *45 mins*	Individual work, monitored, helped. Verbal checking. Agreement, feedback self-correction. Praising.
	Set homework **PB 16.1, Q9 (a), (c), (e), (i), (j)** **PB 16.1, Q10 (a), (c), (e)**	

Y7 UNIT 16 *Algebra: Linear Equations* Lesson Plan 3 — *Function Machines*

Activity		*Notes*
1	**Check homework** **PB 16.1, Q9** **(a)** $5a$ (c) $2c$ **(e)** $10e$ **(i)** $a + 4b$ **(j)** $4x + 2y$ **PB 16.1, Q10** **(a)** $a + b + c$ **(c)** $a + 2b + c$ **(e)** $5b$ *4 mins*	T has asked one of the Ps to write the answers on BB when they arrive. Ps check their work and indicate if they have another answer. T corrects or agrees; self-correction. Praising.
2A	**Revision - mental work** T: Let's do some mental work with simplifying. Are you ready? $2x + 3x$ $5x - 4x$ $3a + 7a$ $8a + 2a + 10a$ $9b + 3b - 4b$ $3y + 1 + 2y$ $2a + 3b - 1$ $7 + x + 2$ $2x - 3 + 4x + 7$	Mental work to warm up. T asks, gives slower Ps time to think, then points to a P to answer, question by question.
2B	**A puzzle** T: Now open your Ex.Bs as you might need them for this next task. Listen carefully as I give you the instructions. Now, Think of a number from 1 to 5 Multiply it by 3 and subtract 2 from the product Double your original number and add this on Add 6 Decrease this sum by the 5th multiple of your original number T: Finished? All the answers were 4 ! ... *(!!!!)* T: How could I possibly know that? You could have chosen any one of 5 numbers. T: I'll read it out again, but this time, write x each time instead of your original number. P (at BB): $3x - 2 + 2x + 6 - 5x$ Simplify the expression and see what happens to the xs. $(3x + 2x - 5x) - 2 + 6 = 4$ So the answer will always be 4, whatever number is chosen to be x. *14 mins*	T reads the text of the task slowly and clearly. Ps do as instructed, writing in their Ex.Bs (stronger ones can do it mentally). Slower Ps might have problems with so many steps, but will have the chance to go over it again at the next stage. Discussion. T reads the text again, Ps write in their Ex.Bs, then a P is called to BB to write down and simplify the expression. Agreement. Praising.
3A	**Mental work - straightforward examples** T: Let's look at something different. Do you remember number machines? T: We'll use a number machine that multiplies the number you put in by (-3). What will you get if you put in: $4 \rightarrow$ *(–12)* $7 \rightarrow$ *(–21)* $(-2) \rightarrow$ *(6)* $-9 \rightarrow$ *(27)* $100 \rightarrow$ *(–300)* $(-200) \rightarrow$ *(600)* etc.	Mental work, mainly with slower Ps (see next task). T asks, points to P, P answers, T agrees (or lets P self-correct), praises, question by question.

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Activity		***Notes***
3B	**Mental work - more involved examples** T: What number did I put in if the answer is (-6) ? How should we work this out? P: We find a number which, when multiplied by (-3) gives (-6). Since division is multiplication in reverse, (-6) has to be divided by (-3) to find the input. So the answer is 2. T: And if the output was 9 ? *(* $9 \div (-3) = -3$ *)*	T helps volunteer P to explain the process. T encourages a slower P to explain how the function machine works in reverse.
3C	**Further examples** T: Now look at these three function machines. What were the inputs? (a) $\square \rightarrow \div 3 \rightarrow 8$ *(* $8 \times 3 = 24$ *)* (b) $\square \rightarrow + 7 \rightarrow 10$ *(* $10 - 7 = 3$ *)* (c) $\square \rightarrow - 4 \rightarrow 6$ *(* $6 + 4 = 10$ *)* *24 mins*	Whole class activity. Discussion, reasoning, answering. After agreement, T can draw on BB table from p59 of Y7B Practice Book; Ps draw it in their Ex.Bs.
4	**Further practice** **PB 16.2, Q3 (a)** 6 **(b)** 4 **(c)** 20 **(d)** 20 *28 mins*	Quick individual work. Ps work in Ex.Bs, then verbal checking. Agreement, feedback, self-correction. Praising.
5A *(continued)*	**Double function machines** T: We've also met double function machines before. Let's look at some. **OS 16.4, Q1** e.g. (a) 4 $\rightarrow$ $+ 7$ $\xrightarrow{11}$ $\times 5$ $\rightarrow$ 55 T: How can we find the input, 4, working back from the output, 55 ? What operations have we used in the machine? *(Addition and multiplication)* T: And what are their inverse operations? *(Subtraction and division)* T: Which operation did we use first in the machine? *(Addition)* T: So which inverse operation do we have to use first? ... and next? *(Subtraction?...division?)* Discussion follows. P_1 (at BB): $55 - 7 = 48$ and $48 \div 5 = 9.6$ P_2 (at BB): $55 \div 5 = 11$ and $11 - 7 = 4$	Whole class activity. Questions appear on OHP, with Q2 covered. Slower Ps come to OHP to calculate, write correct numbers on middle arrows and final results at the end. Other Ps agree, helping if necessary; T praises. An interactive discussion follows. T calls two Ps to BB to do the reverse calculations.

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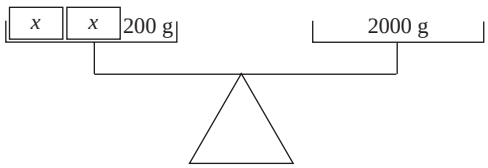
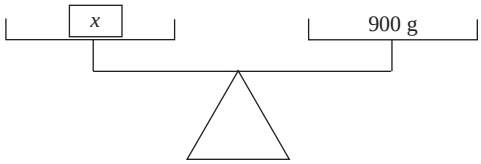
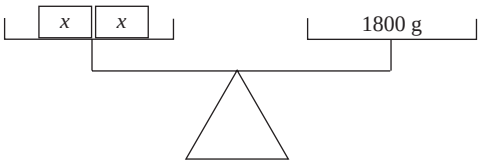
Activity		***Notes***
5A *(continued)*	P_3: Since we need to get the number 11 as our first step, we must start with the inverse calculation of the *final* operation.	A third P explains the correct order for these reverse calculations. T agrees, praises, then asks Ps to explain how to get back to the 6 in question (c). Agreement. Praising.
5B	**Further practice - whole class activity** **OS 16.4, Q2 (b), (c), (a)**	Whole class activity. Volunteer Ps come to OHP to explain and show how to do questions (b) and (c). Then a slower P is encouraged to explain (a) with help from T. Agreement. Praising. Ps copy these explanations into Ex.Bs.
	38 mins	
6A	**Further practice finding the input with double function machines** **PB 16.2, Q4 (a)** 2 **(d)** 6 **(e)** 48	Individual work. T monitors Ps' work and helps slower ones. Stronger Ps can work on Q5 (a) and (b).
6B	**Working with triple function machines** **PB 16.2, Q5 (a)** $25\frac{1}{2}$ or 25.5 **(b)** *7*	When all slower Ps are ready, T stops the work and calls slower Ps to explain the methods used in Q4. Then other Ps explain for Q5 at BB. Agreement, feedback, self-correction. Praising.
	45 mins	
	Set homework **PB 16.2, Q2 (a), (e), (f)** **PB 16.2, Q3 (e), (f)** **PB 16.2, Q4 (b), (f), (h)** **Stronger Ps can also do PB 16.2, Q5 (c)**	

Y7 UNIT 16 *Algebra: Linear Equations* Lesson Plan 4 — *Balancing Equations*

Activity		*Notes*
1	**Checking homework** **PB 16.2, Q2 (a)** 5 **(e)** 3 **(f)** 27 **PB 16.2, Q3 (e)** 9 **(f)** 6 **PB 16.2, Q4 (b)** 17 **(f)** 69 **(h)** – 5 Stronger Ps **PB 16.2, Q5 (c)** –3	T has asked a P to write the answers (only) on BB as soon as P arrives. Other Ps check and correct if necessary. Feedback, self-correction. Praising. Then a stronger P is called to BB to explain how a function machine works in reverse, and show the inverse operations involved.
	6 mins	
2A	**Further practice** T: Let's look at a similar problem: I thought of a number. After dividing it by 3, and then decreasing the quotient by 2, I had the number 6. What was the number I thought of? P_1: ? $\rightarrow$ $\div 3 \rightarrow -2 \rightarrow 6$ P_2: $x \div 3 - 2 = 6$ P_3: $6 + 2 = 8 \rightarrow x \div 3 = 8 \rightarrow x = 8 \times 3 = 24$	Whole class activity. Problem appears on OHP, or can be read aloud by T. After asking a P to read out the text, a volunteer P comes to BB to write the problem as in previous examples lesson. Then T asks if anyone can write it without arrows and question marks. T encourages discussion to define 'equation'. Finally, a slower P should be encouraged to work back through the calculation to find the original number. Agreement. Praising.
2B	**Introducing self-checking** **PB 16.2, Q10** P_1: ? $\rightarrow \times 2 \rightarrow +8 \rightarrow +5 \rightarrow 35$ P_2: $x \times 2 + 8 + 5 = 35$ $x \times 2 + 13 = 35$ P_3: $35 - 13 = 22 \rightarrow x \times 2 = 22 \rightarrow x = 22 \div 2 = 11$ P_4 (checking): $11 \times 2 + 8 + 5 = 35$	T leads Ps to solve the problem as before, but ... ... at the end T shows Ps how to check by substituting their answer into the first equation.
2C	**Real-life example** T: I bought two bags of sugar , and I wanted to check that they did each weight 1 kg, as stated on the labels. So I put the two bags on each side of my scales at home, and they were the same weight. Then I put both bags on the left hand side of the scales and put twenty, 100 gram weights on the right hand side. T: What is the total weight of 20×100 g? *(*2000 g = 2 kg*)* T: So the scales should have balanced, but they didn't. I had to put two 100 g weights on the left hand side to make them balance. How much does one bag of sugar weigh, assuming that they are both the same weight?	Problem may appear on OHP, or can be read aloud by T.
(continued)		

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 4	*Balancing Equations*
Activity		***Notes***
2C *(continued)*	T: Who can write down the equation? P_1: $2x + 200 = 2000$ P_2: $2000 - 200 = 1800 \rightarrow 2x = 1800 \rightarrow x = 1800 \div 2 = 900$ P_3: $900 \times 2 + 200 = 1800 + 200 = 2000$ T: So? Ps: Each bag of sugar weights 900 g (not 1 kg), *22 mins*	T leads Ps to write down the equation in grams on BB. Then P_2 and P_3 Ps come to BB to solve the equation and check the result. Other Ps write it in their Ex.Bs. Agreement. Praising.
3	**Practice with balancing equations** T: Let's look at the 'bag of sugar' problem from another point of view.  T: And what did we want to find out? *(The weight of a bag of sugar)* T: How was the weight represented? *(By the letter x)* T: And the result? *(x = 900 g)* T: Do you mean this ... (and draws another set of scales on BB):  Ps: Yes! T: We've talked about some things we can do that will still keep the scales in balance.. Can you think of something else we could take that would balance the two sides? *(Take 200 g from both sides)* T: And can you draw the scales now? P at BB (sketches): 	Whole class activity. T leads Ps (interactively) to recognising the possibility of balancing an equation. T sketches a set of scales (see OS 16.5) on BB, Ps in Ex.Bs. Then T asks Ps how they would change the contents of the two sides to maintain the balance. T asks Ps to give real examples, e.g. -taking the same things off both sides - putting the same things (weights, bags or other things) on to both sides - halving the contents of both sides - doubling (multiplying) the content of both sides. Finally they agree that the scales will remain balanced if they do the same to both sides. Ps draw in Ex.Bs. Praising.
(continued)		

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 4	*Balancing Equations*
Activity		***Notes***
3 *(continued)*	And what should we do now? *(Halve the amount on each of the sides)* T: Well done! Can you see that solving an equation is like taking off or adding on weights on the scales? We'll look at some more problems. *32 mins*	
4A	**Mental practice** **OS 16.5 (a), (b)** T: What did we do to solve the problem of the bags of sugar? *(We had to reorganise the amounts on the scales)* T: How did we do that? *(We did the same to both sides so that the scales balanced)* T: And what was our aim? *(Our aim was to end up with the unknown value on its own on one side of the scales)* T: So what shall we do first for (a) on OS 16.5? *(Take the weight marked 5 from both sides)* T: Next? *(Take 1 from both sides)* T: Now we have the unknown weight on one side and '1' on the other, so ....? *($x = 1$)* T: Who would like to check that this is correct? *($1 + 5 + 1 = 7 = 5 + 2$)* T: In (b), what is on the left hand side of the scale? *($x + 2$)* T: And on the other side? *($5 + 1 + 5$)* T: What is the total for this side? *(11)* T: What shall we do now? *(Take 2 from both sides, giving $x = 9$)* T: What should we do next? *(Check our result: $9 + 2 = 11$)*	Whole class activity. Problems appear on OHP; Ps work mentally. T helps Ps decide what should be done.
4B	**Writing down the calculations** **OS 16.5 (c)** T: Now write down in your Ex.Bs. an equation to represent problem (c). Who would like to give us their equation? P (dictates, T writes on BB): $2x + 1 = 7 \quad (-1)$ $2x = 6 \quad (\div 2)$ $x = 3$ Check: $2 \times 3 + 1 = 7$	Whole class activity. After writing down the equation, T leads Ps to the solution, as in 4A. At the same time, T shows how the steps should be written, with the 'equals' signs lined up and listing the processes on the right hand side.
4C	**Individual practice** **OS 16.5 (d)** $25 = 3x + 4 \quad (-4)$ $21 = 3x \quad (\div 3)$ $7 = x$ Check: $3 \times 7 + 4 = 25$ *43 mins*	Individual work, monitored, helped. Checking at BB; a P shows the solution in front of the class. Agreement, feedback, self-correction. Praising. Finally, T explains that it is conventional to write the answer as $x = 7$ (not $7 = x$).

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 4	*Balancing Equations*
Activity		***Notes***
5	**Summarising** *45 mins*	At the end of the lesson, T makes Ps summarise the main ideas covered: - the definition of an equation (a statement containing an 'equals' sign and an unknown number) - the reason for solving equations (to find the value of the unknown number) - possible operations to use when solving an equation.
	Set homework **PB 16.3, Q1 (a), (f), (n)** **PB 16.3, Q2 (c), (i), (k)**	

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 5	*Solving Equations 1*
Activity		***Notes***
1	**Checking homework** **PB 16.3, Q1** **(a)** $x = 6$ **(f)** $x = 8$ **(n)** $x = 0$ **PB 16.3, Q2** **(c)** $x = 5$ **(i)** $x = 4$ **(k)** $x = -2$	Check the answers only, except for Q2 (k), which should be reviewed in detail to ensure that Ps really do understand the rules about equations. If Ps seem unsure, further practice will be necessary.
	5 mins	
2A	**Solving equations - practice** T: In Q2 (k) of the homework, what did you do to make the $+2$ disappear? *(We subtracted 2 from both sides)* T: And how did you make the $(\times 6)$ disappear? *(We divided both sides by 6)* T: Right. Now let's look at these problems: **PB 16.3, Q1 (d), (g)**	Whole class activity. Q2(k) from the homework is examined in detail, to check that Ps fully understand. T lets Ps call out what to do and how to solve the problems (also pointing out which are inverse operations). Agreement. Praising. Ps write in Ex.Bs.
	P_1 (d): $x - 4 = 3$ $(+4)$ $x = 7$ Check: $7 - 4 = 3$	
	P_2 (g): $\frac{x}{6} = 4$ $(\times 6)$ $x = 24$ Check: $24 \div 6 = 4$	
2B	**Further practice** **PB 16.3, Q1 (b), (c), (e), (h)**	Individual work. T monitors Ps' work. For checking, four successful Ps come to BB to show and explain the solutions. T has divided BB into 4 sections. Each of the four Ps explains their solution. Agreement, feedback, self-correction. Praising. Discussion follows to emphasise which are the inverse operations.
	P_1: (b) $x + 5 = 11$ (-5) $x = 6$ Check: $6 + 5 = 11$	
	P_2: (c) $x - 6 = 2$ $(+6)$ $x = 8$ Check: $8 - 6 = 2$	
	P_3: (e) $2x = 18$ $(\div 2)$ $x = 9$ Check: $2 \times 9 = 18$	
	P_4: (h) $\frac{x}{5} = 9$ $(\times 5)$ $x = 45$ Check: $\frac{45}{5} = 9$	
	18 mins	

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3	**Two problems** On BB: (a) $x \div 3 - 2 = 1$ (b) $(x - 2) \div 3 = 1$ P_1: $x \div 3 - 2 = 1$ $(+2)$; $x \div 3 = 3$ $(\times 3)$; $x = 9$; Check: $9 \div 3 - 2 = 1$ P_2: $(x - 2) \div 3 = 1$ $(\times 3)$; $x - 2 = 3$ $(+2)$; $x = 5$; Check: $(5 - 2) \div 3 = 1$ *24 mins*	Whole class activity. T divides BB into two parts, and writes down the two problems. Then T asks Ps if there is any difference between the two problems. Volunteer Ps explain the difference and show the solutions on BB. Other Ps listen and write in Ex.Bs. Agreement. Praising.
4	**Another problem** T: Sometimes equations have x on both sides. We need to know how to tackle them. Let's look at this example: $5x - 2 = 2x + 4$ P (at BB): $5x - 2 = 2x + 4$ $(-2x)$; $3x - 2 = 4$ $(+2)$; $3x = 6$ $(\div 3)$; $x = 2$ T (writes on BB): Check: left hand side (LHS) $= 5 \times 2 - 2 = 8$ right hand side (RHS) $= 2 \times 2 + 4 = 8$ *30 mins*	Whole class activity. T writes the equation on BB and waits for Ps' suggestions. Stronger Ps will not have problems, but T can encourage others with questions, e.g. - could you solve the equation if there was not the $2x$ on the right side? - how can we make it disappear? Finally they agree that the first step is to arrange the xs on one side of the equation only. A volunteer P come to BB to show the solution. Other Ps write in Ex.Bs. After agreement and praising, T draws attention to two consequences of having unknown values on both sides: - these equations cannot be solved by looking for the input of a function machine - when checking, expressions on *both* sides must be evaluated. T demonstrates this at BB.
5 *(continued)*	**Individual work** (a) $(x - 4) \times 3 = 15$ (b) $6x + 3 = 4x + 9$ P_1 (at BB): $(x - 4) \times 3 = 15$ $(\div 3)$; $x - 4 = 5$ $(+4)$; $x = 9$ Check: $(9 - 4) \times 3 = 15$	Individual work, monitored, helped. These equations are challenging for slower Ps; T should help them individually. Checking at BB.

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Activity		***Notes***
5 *(continued)*	P_2 (at BB): $6x + 3 = 4x + 9 \quad (-4x)$ $2x + 3 = 9 \quad (-3)$ $2x = 6 \quad (\div 2)$ $x = 3$ Check: LHS $= 6 \times 3 + 3 = 21$ RHS $= 4 \times 3 + 9 = 21$	Agreement, feedback, self-correction. Praising.
	37 mins	
6	**Real-life example** **PB 16.3, Q6 (a)** T (e.g.): - How do we represent Ben's age? - What do we do first? - How do we write it down? - What do we do next? - What number did Ben give? - Write down the equation. P_1 (at BB): $2x - 10 = 8$ P_2 (at BB): $2x - 10 = 8 \quad (+10)$ $2x = 18 \quad (\div\ )$ $x = 9$ Check: $2 \times 9 - 10 = 8$ So Ben is 9 years old.	Whole class activity. When asking questions, T encourages slower Ps to answer showing how to write down the equation. Agreement. Praising. Again a slower P is asked to come to BB and solve the equation. T makes P_2 check carefully, and then give contextual answer to the problem. Agreement. Praising.
	42 mins	
7	**Another problem** Robert and Al are friends. If you double Al's age and then take away 10, you will get Robert's age. The sum of their ages is 26 years. What will be the sum of their ages in 5 years time? (Equation: $x + 2x - 10 = 26$) Solution: $26 + 2 \times 5 = 36$	Individual work. Problem appears on OHP and T gives Ps two minutes to solve it. Checking: T and Ps can discuss how to write an equation to find the friends' ages. Then they can discuss why it is not necessary to do this to get the answer. Praising.
	45 mins	
	Set homework **PB 16.3, Q1 (l), (m), (o)** **PB 16.3, Q2 (h)** **PB 16.3, Q8 (b), (e)** **PB 16.3, Q3 (a)**	

Y7 UNIT 16 *Algebra: Linear Equations* Lesson Plan 6

Solving Equations 2

Activity		*Notes*
1	**Checking homework** **PB 16.3, Q1** **(l)** $x = 18$ **(m)** $x = -14$ **(o)** $x = 2$ **PB 16.3, Q2** **(h)** $x = 9$ **PB 16.3, Q8** **(b)** $x = 3$ **(e)** $x = 9$ **PB 16.3, Q3** **(a)** $x = 1\frac{1}{3}$ or $\frac{4}{3}$ P (Q8 (e), at BB): $5x + 1 = 6x - 8 \quad (-5x)$ $1 = x - 8 \quad (+8)$ $9 = x$ Check: LHS $= 5 \times 9 + 1 = 46$ RHS $= 6 \times 9 - 8 = 46$ P (Q3 (a), at BB): $3x = 4 \quad (\div 3)$ $x = \frac{4}{3}$ Check: $3 \times \frac{4}{3} = 4$ *5 mins*	Verbal checking from Q1 (l) to Q8 (b). If Ps have problems with any of these, T can ask a successful P to solve and explain it at BB. Q8 (e) is the most complex of the questions, and Q3 (a) contains a 'new' problem. These solutions should be worked through in detail at BB by volunteer Ps .
2A/B	**Perimeter problems PB 16.3, Q4, Q7** P_1 (at BB): 12 cm + 11 cm + x = 31 cm P_2 (at BB): $12 + 11 + x = 31$ $23 + x = 31 \quad (-23)$ $x = 8$ Check: $12 + 11 + 8 = 31$ The length of the third side of the triangle is 8 cm. P_3 (at BB): $x + 1 + x + 1 + x + 1 + x + 1 = 9.6$ P_4 (at BB): $4x + 4 = 9.6$ $4x = 5.6 \quad (\div 4)$ $x = 1.4$ Check: $1.4 \times 4 + 4 = 9.6$ The length of the unknown side of the octagon is 1.4 cm.	Whole class activity. T makes Ps recall the notion of perimeter and lets Ps find out how to write down the equations for x. Then different Ps are called to solve equations at BB. Slower Ps should be encouraged and helped. At Q7, T and Ps can also review how to simplify expressions. Agreement. Praising. Ps write in Ex.Bs.
2C	**Individual practice (perimeters) PB 16.3, Q5 (a)** T (write on BB, Ps dictate): $18 + x + 18 + x = 48$ $2x + 36 = 48 \quad (-36)$ $2x = 12 \quad (\div 2)$ $x = 6$ Check: $18 + 6 + 18 + 6 = 48$ (or: $(18 + x) \times 2 = 48$ or: $18 \times 2 + x \times 2 = 48$) *15 mins*	Individual work, monitored, helped. Checking at BB: T makes Ps dictate the solution by asking different Ps to continue, step by step. Agreement, feedback, self-correction. Praising.

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 6	*Solving Equations 2*
Activity		***Notes***
3	**Problems with angles** T: Turn to p66 of your Ex.Bs. The two figures shown each contain three angles. What is the relationship between the two problems? *(The sum of the angles on a straight line and the sum of the angles in a triangle are both* $180°$*)* T: Let's look at the first one.	Questions from the previous section and this one provide a good opportunity to link other topics previously covered: - perimeters - perimeter of a rectangle - dividing and multiplying decimals - the sum of angles on a straight line - the sum of angles in a triangle.
3A	**PB 16.3, Q9 (Whole class)** T: Who would like to write down the equation? *(*$3x + 80 + 2x = 180$*)* T: What is the next step? *(Simplifying the expression on the LHS of the equation)* T: Who can tell me how to do this? *(*$5x + 80 = 180$*)* T: And now ... ? *(*-80*)* T: Which gives $5x = 100$. T: And the last step? *(*$\div 5$*)* T: Giving $x = 20$. T: Have we finished? *(No, we have to determine the size of the two unknown angles)* T: OK; the first one? *(*$3x° = 60°$*)* T: The other one? *(*$2x° = 40°$*)* T: Have we finished now? *(No, we still have to check our answers)* T: Let's do it ... *(*$60° + 80° + 40° = 180°$*)* T: Well done. Try the next one on your own.	Whole class activity. T asks questions, Ps answer, dictate to T what to write. T agrees, praises, T writes on BB, Ps in their Ex.Bs, step by step. For each question, T points to P, P gives the next step, other Ps correct if necessary. T agrees, praises and writes on BB, Ps in Ex.Bs. Praising.
3B	**PB 16.3, Q10 (Individual work)** Solution on OHP: $x + 3x + 40 = 180$ $4x + 40 = 180 \quad (-40)$ $4x = 140 \quad (\div 4)$ $x = 35$ $3x = 105$ Check: $35° + 105° + 40° = 180°$ So the unknown angles are $35°$ and $105°$. *25 mins*	Individual work, monitored, helped. Solution can be shown on OHP, or T can write it on BB, so Ps can check their work themselves. Feedback, self-correction. Praising.
4	**Summarising, mental work** **M16.2** with extra questions **Q11** $\frac{x}{3} - 5 = -1$ **Q12** $3x + 11 = 7x + 3$	At the end of the unit, T and Ps review the topic while going over questions in M 16.2 interactively.

Y7	**UNIT 16** ***Algebra: Linear Equations*** Lesson Plan 6	*Solving Equations 2*
Activity **4** *(continued)*	*45 mins*	***Notes*** The 'Code Wheel and Function Machines' sheet (with the Mental Tests) appears as an OHP. T reads out Q1-Q6, asks questions (see 3A), points to Ps to answer and explain, question by question. Then Q7-Q12 appear on OHP and mental work continues (for Q11 and Q12, T writes the steps on BB). Each question is discussed. Agreement. Praising.
	Set homework **PB 16.1, Q2 (b)** **PB 16.1, Q4 (d), (l)** **PB 16.1, Q9 (b), (k)** **PB 16.2, Q2 (b)** **PB 16.2, Q4 (c)** **PB 16.3, Q2 (j)** **PB 16.3, Q8 (d)**	