Y8	**UNIT 12 *Formulae*** Lesson Plan 1	*Substitutions 1*

Activity

1A

Revision

T: Can you remember how to count?

Ps: Yes.

T: Are you sure? I'm going to test you ...

$7 + 100$	$(= 107)$
$200 - 1$	$(= 199)$
$1 - 200$	$(= -199)$
$6 + 6 + 6 + 6 + 6$	$(= 5 \times 6 = 30)$
$(-3) \times 1000$	$(= -3000)$
$(-7) \times (-8)$	$(= 56)$
$1 + \frac{1}{3}$	$(= 1\frac{1}{3})$
$\frac{1}{3} - \frac{1}{2}$	$(= \frac{2}{6} - \frac{3}{6} = -\frac{1}{6})$
$3.2 \times (-3)$	$(= -9.6)$
$1.8 + 0.5$	$(= 2.3)$
$2 \div \frac{3}{4}$	$(= 2 \times \frac{4}{3} = \frac{8}{3})$
$3 \div 7$	$(= \frac{3}{7})$
$2 \times 2 \times 2 \times 2 \times 2$	$(= 2^5 = 32)$
$(-2)^3$	$(= -8)$
3^3	$(= 27)$
10^2	$(= 100)$
$\sqrt{100}$	$(= 10)$
$(-10)^2$	$(= 100)$
$\sqrt{-100}$	*(cannot be calculated)*
$(7 + 9) \div 2$	$(= 8)$
$44 \times 2 + 56 \times 2$	$(= 100 \times 2 = 200)$

Notes

Mental warm-up activity to revise operations covered previously.

T asks Ps question-by-question, writing each one on BB with the answer given.

It's almost impossible to cover *all* the rules learned so far regarding operations, but T should take every opportunity to reinforce Ps' knowledge.

The rules will be met again when practising substitutions, but should be stated again here when answering questions. For example, 'Since $(-) \times (-) = (+), (-7) \times (-8) = 56$'.

Y8	**UNIT 12 *Formulae*** Lesson Plan 1	*Substitutions 1*
Activity		***Notes***
1B	x | $x-2$ | $\frac{x}{4}$ | $-2x$ | $\frac{8}{x}$ | x^2 | $\sqrt{x}$ 16 | ☐ ☐ ☐ ☐ ☐ ☐ 0 | ☐ ☐ ☐ ☐ ☐ ☐ -4 | ☐ ☐ ☐ ☐ ☐ ☐	Individual work. Task appears on OHP and Ps copy it, or each P is given a copy of the table. Ps fill in the boxes. T walks among Ps, monitoring their work and helping them by reminding them what they need to do. Checking at OHP: encouraged slower Ps come to front to explain and write solutions in the boxes. Agreement, feedback, self-correction. Praising.
	18 mins	
2	**Discussion and mental work with algebraic expressions** T: What type of calculations were shown in the first row of the table on the OHP? *(Different operations with the letter 'x')* T: What do we call them? *(Algebraic expressions)* T: What have you done in rows 2 to 4 ? *(We've evaluated the expressions in three different cases)* T: What do we mean by 'evaluating the expression'? *(Substituting numbers for the letters in an expression)* T: Let's do some more. **OS 12.1**	Firstly a short discussion on algebraic expressions ... ... then mental work with all slower Ps contributing. Task appears on OHP, T asks questions (one at a time) and waits for all Ps to volunteer as quickly as they can. T reminds Ps that, for example, $3 \times p$ is written as $3p$ and $p \div 2$ as $\frac{p}{2}$. Agreement, praising after each question.
	25 mins	
3	**Individual work** **PB 12.1, Q1 (h)** *(12)* **PB 12.1, Q2 (h)** *(70)* **PB 12.1, Q3 (e), (i)** *(36), (18)* **PB 12.1, Q4 (c)** *(3)* **PB 12.1, Q5 (a), (i)** *(50), (2)*	Individual work, monitored, helped. Verbal checking. Agreement, feedback, self-correction. Praising.
	32 mins	
4A *(continued)*	**Formulae using negative numbers** T: Now you'll need to use the rules for negative numbers. **OS 12.3, (a), (c), (e), (g)** P (a): $d + f = (-2) + (-6) = -2 - 6 = -8$ P (c): $ef = e \times f = 5 \times (-6) = -30$ P (e): $2e + 3f = 2 \times 5 + 3 \times (-6) = 10 + (-18) = -8$	Whole class activity. OS 12.3 appears on OHP. Detailed discussion of the substitution of negative numbers in each case, at BB, with slower Ps encouraged and helped for the first 3 parts.

Y8	**UNIT 12 *Formulae*** Lesson Plan 1	*Substitutions 1*
Activity		***Notes***
4A *(continued)*	P (g): $2e(d-2f) = 2\times 5\times\big((-2)-2\times(-6)\big)$ $= 10\times\big(-2-(-12)\big) = 10\times(-2+12)$ $= 10\times 10 = 100$	T asks Ps to write numbers into the expressions correctly, then to recall and use their knowledge of negative numbers (including the rules, '$-(+)=-$', etc.) Agreement. Praising. All Ps write in Ex.Bs.
4B	**OS 12.3 (b), (d), (f)** (b) $e+f = 5+(-6) = 5-6 = -1$ (d) $df = d\times f = (-2)\times(-6) = 12$ (f) $4d-2f = 4\times(-2)-2\times(-6) = (-8)-(-12)$ $= -8+12 = 4$	Individual work, monitored, helped. Checking: one minute before stopping the work, T writes detailed solutions on OS. Feedback, self-correction. Praising.
	42 mins	
5	**Applying a formula** T: Finally, let's look at an example of how we can apply our knowledge to another subject, in this case, science. The distance, D kilometres, travelled along a motorway during T hours at a speed of S kilometres per hour is calculated using the formula $D = S\times T$ Calculate the distance travelled if $S = 90$ and $T = 3$. *($D = 90\times 3 = 270$ (km))*	Task appears on OHP. T gives Ps one or two minutes to read and understand the question. Then discussion with Ps encouraged to devise formulae as algebraic expressions, substituting mentally to determine the answer. Agreement. Praising.
	45 mins	
	Set homework **PB 12.2, Q1 (a), (c) , (f), (g), (i)** **PB 12.2, Q2 (a), (b), (e)** **PB 12.2, Q3 (b), (d), (f)** **PB 12.1, Q10 (b)**	

Y8	**UNIT 12 *Formulae*** Lesson Plan 2	*Substitutions 2*
Activity		***Notes***
1	**Checking homework** **PB 12.2, Q1** **(a)** 4 **(c)** −6 **(f)** −3 **(g)** −12 **(i)** 48 **PB 12.2, Q2** **(a)** 18 **(b)** 10 **(e)** 22 **PB 12.2, Q3** **(b)** −8 **(d)** 6 **(f)** −4 **PB 12.1, Q10** **(b)** 2 hours T: Is there any connection between the formulae (writes on BB: $T = \frac{D}{S}$ $D = S \times T$) ... ... we used in the last part of the previous lesson and in this homework exercise? We'll spend more time on this soon. *5 mins*	T sketches the figures, marking the angles of the quadrilateral in Q5, and asks for the sizes of the angles marked. Agreement, re-measuring, feedback. Praising.
2A (slower)	**Checking homework in detail and practising similar tasks**	T divides Ps into two groups according to the number of mistakes in the homework exercises. Those who had problems sit together and work as a group, using BB, first to check in detail and correct the problem questions, then to strengthen their basic numeracy skills. (Questions can be selected from PB 12.1, Q1-5 and PB 12.2, Q1-3.)
2B (Stronger)	**Activity 12.2, without Extension** *20 mins*	Those who had no (or only one) problem with the homework now work individually, or in pairs, and try to apply their knowledge. Each P is given a copy of Activity 12.2 to work on. (T encourages Ps to use brackets.) After finishing the practice with slower Ps, T stops stronger Ps. Checking will be done later.
3A	**Practice using brackets** T: We also have to know how to use brackets. Can you remember what 'BODMAS' says about brackets? Ps: Brackets first. T: That's right. Let's do that here. **OS 12.2 (a), (b), (c), (e)** P (a): $2(x + 2) = 2 \times (2 + 2) = 2 \times 4 = 8$ P (b): $4(z - x) = 4 \times (6 - 2) = 4 \times 4 = 16$ P (c): $x(y + z) = 2 \times (3 + 6) = 2 \times 9 = 18$ P (e): $2y\,(x + 5z) = 2 \times 3 \times (2 + 5 \times 6) = 6 \times (2 + 30)$ $= 6 \times 32 = 192$	Whole class activity with slower Ps encouraged to contribute. Task appears on OHP; T encourages slower Ps to come out and do substitutions in detail at OHP. Other Ps listen and help if necessary, and write correct solutions in Ex.Bs. T agrees, praises.

Y8	**UNIT 12 *Formulae*** Lesson Plan 2	*Substitutions 2*
Activity		***Notes***
3B	**Individual work with brackets** **OS 12.2, (d)** **PB 12.2, Q4** P (d): $5 \times (2x + 3y) = 5 \times (2 \times 2 + 3 \times 3)$ $= 5 \times (4 + 9) = 5 \times 13 = 65$ P (Q4): $\sqrt{a + b \times c} = \sqrt{15 + 2 \times (-3)} = \sqrt{15 - 6}$ $= \sqrt{9} = 3$ *30 mins*	Individual work. T helps when necessary. Detailed checking at BB, with discussion about root signs being as important as brackets in the order of operations. Agreement, feedback, self-correction. Praising.
4	**Checking Activity 12.2** T (to Ps who worked as a group with T at the beginning of the lesson): Now the other group would like to show us something. While we were working together earlier in the lesson, they were preparing some questions for us. They used only the numbers 1, 2, 7 and 9 to make every number from 1 to 40. They've coded the four numbers like this (writes on BB): $a = 1, \quad b = 2, \quad c = 7, \quad d = 9$ and now have some formulae for the numbers they've produced. e.g: T (to stronger Ps): Who found a formula for the next number asked for? P_1 (writes on BB): $d - c + b - a$ T (to slower Ps): Who'd like to evaluate this and find the number? P_2 (writes on BB): $9 - 7 + 2 - 1 = 3$ T: Who found this formula? Who found a different formula for the number 3 ? Well done! Let's look at another number, ... etc. *38 mins*	Whole class activity. T asks one of the stronger Ps to write on BB the first formula the group produced. Then a slower P evaluates it. Agreement. Praising, asking for the next formula, etc. It's impossible to check *all* the possible solutions, so T asks if anyone found the same formula, or can give a different one for that particular number. Praising. There will not be enough time to complete this activity, so after going through formulae for 6 or 7 numbers, T stops the work and asks stronger Ps to complete it as an extra homework task.
5	**Individual work** **Activity 12.1** *45 mins*	Individual work, monitored, helped. Each P is given a copy of Activity 12.1. T may decide to decode the first two letters as a whole class activity by asking a volunteer P to do the first one and a slower P to do the second. Verbal checking: T asks Ps to call out the message in chorus, then writes it on BB. Feedback. Praising. Self-correction at home by decoding the wrong letters again.
	Set homework **(1) PB 12.2, Q1 (n), (p), (s)** **PB 12.2, Q3, (a), (i)** **PB 12.2, Q6** **(2) Activity 12.1, Q2** **(3) For stronger Ps: Completing Activity 12.2, without Extension**	

Y8	**UNIT 12 *Formulae*** Lesson Plan 3	*Linear Equations 1*
Activity		***Notes***
1A	**Checking homework** **(1) PB 12.2, Q1 (n)** −50 **(p)** 2 **(s)** 25 **PB 12.2, Q3 (a)** 20 **(i)** 2 **PB 12.2, Q6** 7.26 cm	Checking the first set of homework questions: T writes results on BB → feedback → reviewing (at BB) detailed solution of those questions which caused problems.
1B	**(2) Activity 12.1, Q2** **(3) Completing Activity 12.2 (for stronger Ps)**	T arranges Ps in pairs (e.g. by seating) and gives them 4 or 5 minutes to change their messages and decode them. The members of each pair will discuss if the decoding was successful, so will check at the same time. Agreement, correction in each pairing. T monitors discussion, helps wherever necessary and puts 'Notes for Solutions' of Activity 12.2 on OS, for stronger Ps to check and complete their extra homework while slower Ps decode. Feedback. Praising.
	10 mins	
2	**Further evaluations** T: Let's look at the evaluation of slightly longer algebraic expressions, for example (writes on BB): $6x + 3 - x - 2 - 4x$ and substitute $x = -1$. How do we do this? Ps: First we must simplify the expression. P (at BB): $= (6x - x - 4x) + (3 - 2) = x + 1$ $= -1 + 1 = 0$ T: These are not too difficult, so you can do them in your head:	Revision and warming-up activity. Firstly T reminds Ps to simplify algebraic expressions, and asks a volunteer P to explain at BB how to do this.
	T: $3x + 4x$ Ps: $7x$ $7x - 2x$ $5x$ $5a + 4a + 1$ $9a + 1$ $5a + 4a + a$ $10a$ $7b - 2b + 3b$ $8b$ $4x + 1 - 3x + 2$ $x + 3$	Then mental work. T asks, gives slower Ps time to think (may write on BB or repeat expression), then points to a P to answer, question by question. Praising
	15 mins	
3A *(continued)*	**Revision: solving simple equations** T: Algebraic expressions also appear in equations (puts OS on OHP). **OS 12.4 A (a), (b), B (a), (d)** T: You can see some very simple equations on the OHP. What do we need to do?	Whole class activity/mental work to revise previous work on solving simple equations.

Y8	**UNIT 12 *Formulae*** Lesson Plan 3	*Linear Equations 1*
Activity		***Notes***
3A *(continued)*	*(Find the number represented by 'x' which will make the equation true)* T: How do we do this? *(We have to reorganise the equation, keeping the balance, so that the unknown value is by itself on one side)* T: What do we need to do with the examples on the OHP? P (Aa): For $x + 6 = 21$, the 6 must disappear from the left hand side. To keep the balance, we subtract 6 from each side. So $x = 15$. P (Ab): For $x - 4 = 15$, we have to add 4 to each side to make the 4 disappear from the left hand side, leaving us with $x = 19$. P (Ba): For $4x = 24$, dividing both sides by 4 gives $x = 6$. P (Bd): For $\frac{x}{4} = 3$, we multiply each side by 4 to give $x = 12$. T: What have you done in each of these examples? *(We've done the inverse of each of the operations)*	Solving linear equations (as a fundamental topic) has been revisited several times since Ps studied it last year. They reviewed it in Y8, Unit 8 (and in Unit 9) in detail and slower Ps were given an extra lesson to practice linear equations then. So now simple equations will only be looked at and, after reviewing mentally how to tackle different examples, some individual work will be enough (we hope) for Ps to recall their basic knowledge of this topic.
3B	**Individual work** **PB 12.3, Q1 (c)** *(2)* **(h)** *(11)* **(l)** *(−4)* **PB 12.3, Q2 (e)** *(4)* **(f)** *(0)* **(k)** *(44)* *25 mins*	Individual work. Verbal checking, Looking in detail at BB at only those problems which caused problems. (Also remind Ps of the convention of giving the solution with the unknown value on LHS, and reminding them to check the result by substituting it in the original equation.) Agreement, feedback, self-correction. Praising.
4	**Solving equations** T: In the previous questions you needed only one step to reach the unknown value. Now we'll look at two other kinds of problem. (A) I thought of a number. After multiplying it by 2 and then increasing the product by 4, I had the number 12. (B) My friend, Nick, also thought of a number. After increasing it by 4, and then multiplying the sum by 2, he also had the number 12. What were the numbers we each thought of? P (A): $x \times 2 + 4 = 12$ P (B): $(x + 4) \times 2 = 12$	Whole class activity. The two problems appear on OHP. After asking two Ps to read out the problems, T divides BB into two parts, and two volunteer Ps come to front to write the two equations. Agreement. Praising. T asks Ps if there is any difference between the two problems. After volunteer P's explanation, T and Ps agree that solving the equation must start with the inverse calculation of the final operation.
(continued)		

Y8	**UNIT 12 *Formulae*** Lesson Plan 3	*Linear Equations 1*
Activity		***Notes***
4 *(continued)*	P_3: $x \times 2 + 4 = 12$ (-4) $x \times 2 = 8$ $(\div 2)$ $x = 4$ *Check*: $4 \times 2 + 4 = 12$ P_4: $(x + 4) \times 2 = 12$ $(\div 2)$ $x + 4 = 6$ (-4) $x = 2$ *Check*: $(2 + 4) \times 2 = 12$	Then two slower Ps are encouraged (and helped) to show the solutions on BB, one at a time. Other Ps listen (help if necessary) and write in Ex.Bs. Praising.
	34 mins	
5	**Individual work** **PB 12.4, Q1 (c)** *(2)* **(d)** *(6)*	Individual work, monitored, helped. Checking: T points to Ps to dictate the steps, waits for correction or agreement, and writes correct solutions on BB, step by step. Feedback. Praising.
	42 mins	
6	**Revision: expanding brackets** T: Can you remember how to expand brackets? Can you show me another way to solve the second question in the previous task? P: $3(x + 4) = 30$ $3x + 12 = 30$ (-12) $3x = 18$ $(\div 3)$ $x = 6$	Discussion at the end of the lesson: a volunteer P reminds the others of this topic from Unit 8 by multiplying out the brackets in the equation $3(x + 4) = 30$. Agreement. Praising.
	45 mins	
	Set homework **PB 12.3, Q3 (g), (h), (i), (l)** **PB 12.3, Q4** **PB 12.4, Q1 (b), (h), (e)**	

Y8	**UNIT 12 *Formulae*** Lesson Plan 4	*Linear Equations 2*
Activity		***Notes***
1	**Checking homework** **PB 12.3, Q3 (g), (h), (i), (l)** T: In Q3 (g), what did you do to make the 4 disappear? P_1: I subtracted 4 from both sides, so $x = 11$. etc. **(h)** $y = 16$, **(i)** $p = 7$, **(l)** $s = -32$ **PB 12.3, Q4** T: What equation have you written down for Q4, and how did you solve it? P_2: $x \times 6 = 18$, so both sides had to be divided by six to get $x = 3$ cm. **PB 12.4, Q1 (b)** *(3),* **(h)** *(−1),* **(e)** *(3)*	Quick verbal checking of Q3 and Q4, reviewing mentally the basic knowledge learned so far (especially for slower Ps). Again, slower Ps are encouraged to show their solutions to the third part of the homework, this time at BB. Three of them write their solution on BB (divided into three parts) simultaneously. Other Ps agree or suggest corrections. Solution of part (e) should be shown in both ways (starting with dividing both sides by 5 or multiplying out the brackets) so after agreement, a volunteer P explains the alternative method at BB. Self-correction, feedback. Praising.
	9 mins	
2 *(continued)*	**Writing contexts from equations** T: In the last lesson, you wrote down two equations from the numbers my friend and I had thought of. Now I'm going to give you two equations and you have to make up the contexts to go with each one. $\frac{x}{3} + 2 = 4$ $\quad\quad$ $\frac{x+2}{3} = 4$ P_1: I thought of a number. I divided it by 3, increased the quotient by 2, and then had the number 4. P_2: I thought of a number. I added 2 to it, then divided the sum by 3, and got the number 4. T (to non-volunteering Ps): What is the final operation in the first equation? *(Addition)* T: So the first thing we do is ...? *(Subtract 2 from both sides)* T: Come to the BB and do it. P_3 (at BB): $\frac{x}{3} + 2 = 4 \quad (-2)$ $\frac{x}{3} = 2 \quad (\times 3)$ $x = 6$ *Check*: $6 \div 3 + 2 = 4$	Whole class activity. T divides BB into two parts, writes down equations and asks volunteer Ps to read out their contexts. Other Ps listen ... ... and slower ones answer the questions posed by T, then solve equations at BB. (T helps them.)

Y8	**UNIT 12 *Formulae*** Lesson Plan 4	*Linear Equations 2*
Activity		***Notes***
2 *(continued)*	T: And the second equation? *(There the final operation is a division)* T: So? P_4 (at BB): $\frac{x+2}{3} = 4 \quad (\times 3)$ $x + 2 = 12 \quad (-2)$ $x = 10$ *Check*: $(10 + 2) \div 3 = 4$	Praising. All Ps write in Ex.Bs.
	18 mins	
3	**Individual work: further practice** **PB12.4, Q2 (c), (j)** **Q2 (c):** P (at BB): $\frac{y}{5} - 9 = -2 \quad (\times 5)$ $y - 45 = -10 \quad (+45)$ $y = 35$ **Q2 (j)** *($p = 34$)*	Individual work, monitored, helped. T asks those (probably stronger) Ps who finish their work before T stops them, to find another way to get '*x*' in Q2 (c). Checking: T writes solutions on BB (quickly), Ps check and correct their answers. Feedback. Praising. Then T asks for the alternative way. Agreement, feedback. Praising. All Ps write the alternative method in Ex.Bs.
	27 mins	
4A *(continued)*	**Rearranging and then solving equations** T: Let's look again at equations of the sort we met earlier this year and see if you can still solve them. **PB 12.4, Q3 (b), (g)** T (writes on BB): $6x - 2 = 4x + 7$ P_1: The first step is to arrange the *'x'*s on one side of the equation, so let's subtract $4x$ from both sides. T: $2x - 2 = 7$ T (to a slower P): And now? P_2: Let's add 2 to both sides. T: $2x = 9$ P_3 (slower): Then dividing both sides by 2, we get $x = 4.5$. T: $x = 4.5$ P_4: To check, we have to do substitutions on both sides. Here, on the LHS, $6 \times 4.5 - 2 = 27 - 2 = 25$, while ... P_5 (slower): $4 \times 4.5 = 18$ and $18 + 7 = 25$ T: Now on to part (g). What do we do first? *(We multiply out the brackets)* Slower P at BB: $9(x + 7) = 2(5x - 7)$ $9x + 63 = 10x - 14 \quad (-9x)$	Whole class activity. T writes the first equation on BB and waits for Ps to give instructions for the next step. Ps dictate, T agrees and writes on BB, Ps write in Ex.Bs. T writes on BB. T writes the second equation on BB, asks for the first step, then points to a slower P to solve equation at BB (perhaps with help).

Y8	**UNIT 12 *Formulae*** Lesson Plan 4	*Linear Equations 2*
Activity		***Notes***
4A *(continued)*	$63 = x - 14 \qquad (+14)$ $77 = x$ $x = 77$ Stronger P at BB: LHS $= 9 \times (77 + 7) = 9 \times 84 = 756$ RHS $= 2 \times (5 \times 77 - 7) = 2 \times (385 - 7) = 2 \times 378 = 756$	T agrees, praises and asks a (stronger) volunteer P to evaluate both sides (quickly). Ps write in Ex.Bs. Praising.
4B	**Individual practice** **PB 12.4, Q3 (c)** *(3)*, **(f)** *(11)*	Individual work, monitored, helped. Checking at BB: volunteer Ps write and explain solutions. Agreement, feedback, self-correction. Praising, encouraging and reassuring those who failed that they will have the opportunity to go over this topic again later.
	41 mins	
5	**Preparing for the next topic** **PB 12.4, Q6 (a)** T (writes what is dictated by Ps): $v = u + at$ $10 = 3 + a \times 5 \qquad (-3)$ $7 = a \times 5 \qquad (\div 5)$ $1.4 = a$ $a = 1.4$ *Check*: RHS $= 3 + 1.4 \times 5 = 3 + 7 =$ LHS	A whole class activity in preparation for the next lesson. Ps read the problem, T writes the formula on BB, waits for Ps' suggestions, agrees and writes what they dictate. Ps write in Ex.Bs. Praising.
	45 mins	
	Set homework **PB 12.4, Q2 (a), (h)** **PB 12.4, Q6 (b)** **PB 12.4, Q3 (d), (e)**	

Y8	**UNIT 12 *Formulae*** Lesson Plan 5	*Changing the Subject of a Formula*
Activity		***Notes***
1	**Checking homework / mental work**	
1A	**PB 12.4, Q2 (a)** $x = 8$ **(h)** $x = -1$ **PB 12.4, Q6 (b)** $a = -1$	T has asked three slower Ps to write solutions of the first three homework exercises in detail on BB as soon as Ps arrive. T agrees or waits for correction. Feedback, self-correction. Praising.
1B	**Mental work** **M 12.2** T: When you solve equations you have to use lots of basic knowledge. Let's warm up with some now.	Mental work with all slower Ps contributing. Questions appears on OHP, T reads out the questions, points to a (slower) P to answer. Agreement/correction and praising, question by question.
1C	**Homework PB 12.4, Q3 (d)** T (writes on BB): $11x + 2 = 8x + 7 \quad (-8x)$ $3x + 2 = 7 \quad (-2)$ $3x = 5 \quad (\div 3)$ $x = \frac{5}{3} = 1\frac{2}{3}$ T: As you can see, you also need to be able to work with fractions.	T writes solution of Q3 (d) quickly on BB. Ps check and correct their work.
	P_1: LHS $= 11 \times \frac{5}{3} + 2 = \frac{55}{3} + 2 = 18\frac{1}{3} + 2$ $= 20\frac{1}{3}$ P_2: RHS $= 8 \times \frac{5}{3} + 7 = \frac{40}{3} + 7 = 13\frac{1}{3} + 7$ $= 20\frac{1}{3}$	After feedback (and praising), T calls two Ps who failed here to check the result and do some practice with fractions by evaluating LHS and RHS at the same time. Praising.
1D	**Homework PB 12.4, Q3 (e)** $x = 3$	Another P who failed with Q3 (d) is chosen to show and explain (with T's help) the solution of the final homework exercise, in detail at BB.
	13 mins	
2A	**Calculations using formulae** T: Let's go back to some easier questions. The time, T hours, taken to travel D kilometres along a motorway at a speed of S kilometres per hour is calculated using the formula $T = \frac{D}{S}$ Calculate the distance D travelled, if: (a) $T = 3$ and $S = 80$ (b) $T = 2$ and $S = 95$ (c) $T = 2.5$ and $S = 90$	Whole class activity. Task appears on OHP. T asks a P to read out the text (it might be familiar) and another P to substitute T and S in part (a) at BB, and to solve the equation.
(continued)		

Y8	**UNIT 12 *Formulae*** Lesson Plan 5	*Changing the Subject of a Formula*
Activity		***Notes***
2A *(continued)*	P_1 (at BB): $T = \frac{D}{S}$ $3 = \frac{D}{80}$ $(\times 80)$ $240 = D$ $D = 240$ (km)	Then two other (slower) Ps do the same at BB. T agrees, praises in each case. Ps write in Ex.Bs, then T introduces the new topic. Questions/answers interactively.
	P_2: $2 = \frac{D}{95}$ $(\times 95)$ $190 = D$ $D = 190$ (km)	
	P_3: $2.5 = \frac{D}{90}$ $(\times 90)$ $225 = D$ $D = 225$ (km)	
2B	**Further work with formulae** T: And if I asked you to calculate distances in another hundred similar cases, would you multiply both sides and arrange D on the LHS one hundred times? What else should you do? *(Use letters instead of the numbers we have used so far)*	
	P_4: $T = \frac{D}{S}$ $(\times S)$ $S \times T = D$ $D = S \times T$	T writes the two formulae on BB.
	T: In the homework from the first lesson in this unit, you used $D = S \times T$ and $T = \frac{D}{S}$, and I asked you if there was any connection between the two equations.	
	P_5: The two formulae show connections between the same letters, but they are arranged in different ways.	
	P_6: Each gives different letters.	
	T: Yes, we say that D is the subject of the formula $D = S \times T$, while T is the subject of the other formula. How do we get from one to another? ... What have you done? *(We did the same as we do when we solve equations)*	
	T: We say that we have rearranged the formula to change its subject. Can you rearrange one of them to make the third letter the subject? Which formula would you choose?	
	T (writes): $D = S \times T$ $(\div T)$ $\frac{D}{T} = S$ $S = \frac{D}{T}$	Volunteer P suggests and dictates solution. T agrees, praises, writes on BB (Ps in Ex.Bs) and draws attention to the convention of writing the subject of the formula on the left hand side of the equation.
	21 mins	

Y8	**UNIT 12 *Formulae*** Lesson Plan 5	*Changing the Subject of a Formula*
Activity		***Notes***

3

Changing the subject of formulae

T: Let's see some simple changing (writes):

As you can see, y is the subject of each of these formulae. Rearrange each one so that x is the subject.

$y = x + 4$	$y = x - 4$	$y = 4x$	$y = \frac{x}{4}$
$P_1: (-4)$	$P_2: (+4)$	$P_3: (\div 4)$	$P_4: (\times 4)$
$y - 4 = x$	$y + 4 = x$	$\frac{y}{4} = x$	$4y = x$
$x = y - 4$	$x = y + 4$	$x = \frac{y}{4}$	$x = 4y$

Whole class activity.

T writes the four formulae on BB (dividing it vertically into four parts) and asks how to change the subject, in each case.

After agreement, T points to four slower Ps to rearrange the formulae on BB, at the same time. Monitors, helps if necessary, praises. Ps write in Ex.Bs.

26 mins

4A

Further work on changing the subject of a formula

T: In your last homework you had some slightly more difficult formulae. Let's look once more at what we do to get a ... (writes on BB):

$$v = u + a \times t$$
$$2 = 5 + a \times 3 \qquad (-5)$$
$$-3 = a \times 3 \qquad (\div 3)$$
$$-1 = a$$
$$a = -1$$

T writes solution of PB 12.4, Q6 (b) from homework on BB ...

T: Now try to change the subject of this formula. Remember that we decided to use the same approach as for solving equations.

P: $v = u + a \times t \qquad (-u)$

$v - u = a \times t \qquad (\div t)$

$$\frac{v - u}{t} = a$$
$$a = \frac{v - u}{t}$$

... and a volunteer P tries to do the same with letters (T may help).

T: Let's substitute v, u and t to check our formula.

$$a = \frac{2 - 5}{3} = -1$$

Then checking mentally by evaluating the RHS of the formula.

4B

Practice

T: Can you tell me what I should do to change the subject in these formulae:

$y = 3x + 2 \qquad y = \frac{x}{3} - 2$

P_1: $y = 3x + 2 \qquad (-2)$

$y - 2 = 3x \qquad (\div 3)$

Whole class activity.

Suggestions, agreement, then two slower Ps (one after the other) are asked to write on BB and say aloud the steps needed. (T may help them.)

(continued)

Y8	**UNIT 12 *Formulae*** Lesson Plan 5	*Changing the Subject of a Formula*
Activity		***Notes***
4B *(continued)*	$\frac{y-2}{3} = x$ $x = \frac{y-2}{3}$ P_2: $y = \frac{x}{3} - 2$ $(+2)$ $y + 2 = \frac{x}{3}$ $(\times 3)$ $(y+2) \times 3 = x$ $x = (y+2) \times 3$	Praising.
	35 mins	
5	**Individual work** **PB 12.6, Q1 (a)** $(x = y + 2)$ **(e)** $(x = \frac{y-1}{2})$ **(h)** $(x = \frac{y}{3} + 4$ or $x = \frac{y+12}{3})$ **PB 12.6, Q3** $(x = \frac{2y+7}{3})$	Individual work. T monitors and helps Ps' work and stops them when all have finished Q1. By then, stronger Ps will probably have finished Q3 and, after discussing solutions to Q1 (at BB, in detail), one of them will show and explain (also at BB) solution of this problem which contains more than one step. (Slower Ps listen and copy.) Agreement, feedback, self-correction. Praising.
	43 mins	
6	**Further practice rearranging a formula** **PB 12.6, Q4**	Finally T encourages a slower P to rearrange this formula, which has 3 steps, at BB (with help). All Ps write in Ex.Bs. Praising.
	45 mins	
	Set homework **PB 12.6, Q1 (b), (c), (d), (f), (g)** **PB 12.6, Q6**	